Vol. 8, No. 4 December, 1954

Canadian Journal of Psychology

THE JOURNAL OF THE CANADIAN PSYCHOLOGICAL ASSOCIATION

UNIVERSITY OF MICHIGAN
DEC 28 1954
SOCIAL SCIENCE LIBRARY

EDITOR: J. D. KETCHUM
ASSISTANT EDITOR: H. O. STEER

EDITORIAL ADVISORY BOARD
D. O. HEBB, *Chairman*
J. BLACKBURN, R. B. MALMO, N. W. MORTON, C. R. MYERS

CONTENTS

Electromyographic reaction to strong auditory stimulation in psychiatric patients: JOHN F. DAVIS, ROBERT B. MALMO, & CHARLES SHAGASS 177

Psychometric differences between senile dementia and normal senescent decline: HERBERT DÖRKEN, JR. 187

A study of anxiety in a general hospital setting: MORGAN W. WRIGHT 195

The relationship between reversible perspective and embedded figures: P. LYNN NEWBIGGING 204

Non-visual perception of the postural vertical: III. Diagonal planes: W. C. CLEGG 209

Testing logical keys in measures of attitude: MAURICE F. FREEHILL & ALEXANDER MILTON 214

An electromyographic study of listening and talking: A. ARTHUR SMITH, ROBERT B. MALMO, & CHARLES SHAGASS 219

An electromyographic study of attentive listening: HARVEY WALLERSTEIN 228

Book reviews 239

PUBLISHED QUARTERLY

MARCH - JUNE - SEPTEMBER - DECEMBER

THE UNIVERSITY OF TORONTO PRESS

$4.00 PER YEAR

ALL RIGHTS RESERVED

Canadian Psychological Association

1954-1955

COUNCIL

Honorary President, R. B. LIDDY, *London, Ontario*

EXECUTIVE: President, FATHER NOËL MAILLOUX, Montreal; Past President, D. C. WILLIAMS, Toronto; President Elect, G. A. FERGUSON, Montreal; Secretary-Treasurer, D. BINDRA, Montreal.

DIRECTORS: J. M. BLACKBURN, Kingston; R. B. MALMO, Montreal; E. I. SIGNORI, Vancouver; A. H. SMITH, Kingston; B. M. SPRINGBETT, Winnipeg; G. H. TURNER, London.

STANDING COMMITTEES

MEMBERSHIP COMMITTEE: Chairman, DALBIR BINDRA, Montreal; F. T. SNODGRASS, Fredericton; LOUISE THOMPSON WELCH, Halifax; D. J. L. BÉLANGER, Montreal; G. DUFRESNE, Montreal; F. R. WAKE, Ottawa; JEAN BROWN, Toronto; A. H. SHEPHARD, Toronto, G. H. TURNER, London, G. A. MCMURRAY, Saskatoon; G. M. DUNLOP, Edmonton; E. I. SIGNORI, Vancouver; M. H. MUNRO, Vancouver.

COMMITTEE ON PUBLICATIONS: Chairman, D. C. WILLIAMS, Toronto; E. W. BOVARD, Toronto; A. H. SHEPHARD, Toronto; C. M. MOONEY, Toronto.

FINANCE COMMITTEE: Chairman, C. M. MOONEY, Toronto; with power to add.

COMMITTEE ON PROFESSIONAL STANDARDS: Chairman, O. E. AULT, Ottawa, E. A. BOTT, Toronto; G. A. FERGUSON, Montreal; L. H. ST. PIERRE, Montreal.

COMMITTEE ON SCIENTIFIC AND PROFESSIONAL ETHICS: Chairman, LOUISE THOMPSON WELCH, Halifax; S. N. F. CHANT, Vancouver; E. C. WEBSTER, Montreal; L. T. DAYHAW, Montreal; G. DUFRESNE, Montreal.

ELECTIONS COMMITTEE: Chairman, N. W. MORTON, Ottawa; with power to add.

C.P.A. REPRESENTATIVE ON THE CANADIAN SOCIAL SCIENCE RESEARCH COUNCIL: C. R. MYERS, Toronto.

1955 ANNUAL MEETING
DALHOUSIE UNIVERSITY
HALIFAX, N.S.

CANADIAN JOURNAL OF PSYCHOLOGY: Correspondence regarding subscriptions should be sent to the Secretary-Treasurer, Canadian Psychological Association, 3600 McTavish St., Montreal, Que. Manuscripts or correspondence on editorial matters or advertising should be sent to the Editor, J. D. Ketchum, 100 St. George Street, Toronto 5, Ontario, Canada.

REGIONAL REPRESENTATIVES: E. S. W. Belyea (*British Columbia*); D. E. Smith (*Alberta*); G. A. McMurray (*Saskatchewan*); B. M. Springbett (*Manitoba*); J. M. Brown (*Ontario*); G. A. Ferguson, D. Bélanger (*Quebec*); W. H. D. Vernon (*Maritimes*).

The Canadian Psychological Association also issues THE CANADIAN PSYCHOLOGIST which is distributed to members only. EDITOR: Dr. Georges Dufresne, 49 Spring Grove Crescent, Montreal, P.Q., Canada.

AUTHORIZED AS SECOND-CLASS MAIL, POST OFFICE DEPARTMENT, OTTAWA.

D. C.
asurer,

GNORI,
URNER,

F. T.
ANGER,
oronto;
atoon;
ouver.
E. W.

o add.
ttawa,
l.
irman,
BSTER,

o add.
ARCH

ptions
3600
ers or
Street,

Smith
J. M.
ernon

OLO-
resne,

Vol. 8, No. 4 December, 1954

Canadian Journal of Psychology

ELECTROMYOGRAPHIC REACTION TO STRONG AUDITORY STIMULATION IN PSYCHIATRIC PATIENTS[1]

JOHN F. DAVIS, ROBERT B. MALMO, AND CHARLES SHAGASS[2]
Allan Memorial Institute of Psychiatry, Montreal

MALMO, Shagass, and J. F. Davis found normal startle reflexes in the psychoneurotic patients they studied (5). This seems to contradict the ordinary clinical observation that "tense," apprehensive, anxious patients are easily startled ("jump at any sudden noise"). We shall see in a moment, however, that the contradiction is only apparent. The startle pattern has been beautifully detailed in the classic study of Landis and Hunt, who used a high-speed movie camera to record reactions to pistol shot. They found a latency up to about 0.2 seconds for the arm component of the startle pattern (3). It was this component which Malmo and his co-workers studied with strong auditory stimulation and electromyographic techniques. The need for their work with psychiatric patients was clear: although Landis and Hunt had studied psychotics and other deviating individuals, they had not investigated the startle pattern in psychoneurotics. Malmo and his co-workers found no significant difference between patients and controls in the 0.2-second period of reflex startle. Curves for mean percentage change showed almost identical values for the first and second tenth-seconds. But beginning with the third tenth-second the control curve fell while the patients' curve continued to rise (5, p. 327). The period beginning after 0.2 second, in which patients and controls differed in reaction, was called the after-response period.

We now see that the experimental data need not be considered contradictory to clinical observations (of "jumpiness" to sound). Without recording instruments it is impossible to gauge the precise latencies of reactions, and the clinician may be observing an exaggerated after-reaction in the patient, not an abnormally strong immediate reflex reaction. The possible theoretical implications of this distinction between

[1]This investigation was supported by the Research and Development Division, Office of the Surgeon General, Department of the U.S. Army, under Contract Number DA-49-007-MD-70.

[2]The authors wish to express their appreciation to Dr. A. A. Smith for advice on statistical procedures and Mr. R. E. Quilter for technical assistance.

immediate and delayed reactions were discussed in the paper by Malmo and his co-workers.

Procedure in the previous study was very similar to that of R. C. Davis, who was one of the first to study electromyographic reaction to strong auditory stimulation (2). In the present study we departed from the R. C. Davis method in a number of ways. Because of our interest in the after-reaction, we shortened the duration of stimulation. Other changed features were elimination of induced tension, reduction in stimulus intensity, and change in its quality from pure tone to white noise. In the main, these changes were introduced in order to test the generality of conclusions from the previous study by Malmo *et al.* Significant instrumental improvements were also made in the interval between experiments. Development of ink-writing electronic integrators, for example, considerably improved the reliability of our measurements. To sum up the main purposes of this investigation, we sought: (*a*) to determine whether deviant reaction to sound could be elicited under conditions other than the specific ones of the previous experiment; and (*b*) to verify the original observations with improved techniques of recording and measurement.

Methods

Subjects. Thirty individuals were studied. There were three groups of ten each: normal controls, psychoneurotics, and schizophrenics. Each group consisted of five males and five females. The control group (ages 18–44, median 24.0) was composed of healthy female department store personnel and male Air Force personnel.[3] The psychoneurotic group (ages 21–40, median 26.5) consisted of patients selected for a high anxiety level, as reflected in severe clinical symptoms and high sedation thresholds (6). Of the schizophrenic group (ages 18–40, median 22.5), none were intellectually deteriorated, and all but four were in hospital for acute psychotic episodes.

Apparatus. Several methodological changes were introduced for the present study. A more sensitive electromyograph was available, so that the complication caused by induced tension (which previously had been necessary to bring muscle potentials to measurable level) was not required. Automatic multichannel integrators replaced the former rather crude method of measuring the highest spike in each tenth-second. We used "white noise"[4] instead of sine waves in order to eliminate troublesome standing waves in the external ear canal (7, p. 53).

---

[3]We wish to acknowledge, with gratitude, the cooperation of those Royal Canadian Air Force personnel and employees of Henry Morgan & Company of Montreal who acted as control subjects. We also thank those officers and officials who permitted these control studies to be made, and who assisted with arrangements.

[4]"White noise" is analogous to white light in the sense that it covers too large a portion of the audible frequency spectrum to have any tonal quality, and that equal amounts of energy are present in equal frequency bands within this spectrum. The random noises generated by resistors, tubes, etc., are familiar examples of white noise.

Pairs of cellulose sponge electrodes, two inches apart, were applied to the extensor crest of the forearm and to the masseter and sternomastoid muscles, all on the dominant side. Electromyographic (EMG) potentials from these three bipolar leads were recorded on three channels of an Edin electromyograph (1, p. 74). The subject lay on a hospital bed in a position of maximum comfort and relaxation. He was told not to react in any way to the stimuli.

The stimulus was a burst of white noise with a duration of 0.125 sec. $\pm$ 20 per cent, administered binaurally through dynamic headphones.[5] The noise generator was a neon tube followed by an amplifier which passed all frequencies between 200 and 5000 cycles per second (6 db points).

Although intensity comparison of white noise with pure tone is difficult, all observers agreed that the stimulus used in the present experiment was less loud than that used in the previous experiment of this series.

Ten stimuli were administered at one-minute intervals. To establish a base line of tensional level, five-minute rest periods were recorded before and after the series of stimuli.

The outputs from the EMG channels were fed to an automatic recording integrator which made integrations at the rate of ten per second and recorded them on a second chart drive (1, p. 64). The stimulus signal was also fed to this integrator, so that a clear record of onset and cessation of stimulus appeared on the secondary tracing. In order to ensure that the onset of each stimulus corresponded with the beginning of an integration it was necessary to use an electronic synchronizer, specially developed for this purpose.

Procedure. Instructions to the subject were similar to those given in the original test. He was reassured about the experimental situation both before the test and, in the more anxious patients, as required during the test. He was given sample stimuli before the test, one of which was as loud as those administered during the test. He was also warned 45 seconds before the first stimulus to expect the first noise "soon." A rough clinical assessment of hearing function was used to screen out any cases of gross hearing defect.

After the test the subject was interviewed with respect to his subjective reactions to the stimuli and, in the case of normal controls, a checkup of medical history and employment record was also made. Those cases which gave a history of treatment for any psychiatric condition or of extremely frequent job changes were eliminated from the series, as were also two subjects on thyroid therapy. This elimination of subjects from the control group was, of course, done quite independently of their test results.

Treatment of data. Measurement of the integrated EMG tracings was done as follows. The amplitude of each tenth-second deflection was measured for one second before and two seconds following each stimulus. This was done for all three muscle channels (masseter, sternomastoid, and extensor). The mean for each tenth-second was calculated for the first four stimuli and for all ten stimuli. Group means and medians for each tenth-second were also worked out for the period from one second before to one second after the stimulus. Statistical analysis of the group data was carried out for each tenth-second, using the non-parametric (rank-total) methods of Wilcoxon (8).

[5]The headphones were Canadian Army dynamic phones as used in the Mark 19 Signals Receiver. Voice coils were 50 ohms each, wired in parallel, and checked for identity of phasing. The noise input to the phones was 0.20 volts RMS.

Results

Significant differences between patients and controls were found only for the extensor muscles of the forearm. The patient-control differences seen in the masseter and sternomastoid muscles were in the expected direction, but did not prove significant. Further, the schizophrenic group showed much less significant differences from controls than did the psychoneurotics, although in general the differences were in the same direction. The following remarks apply only to the psychoneurotic patients and controls.

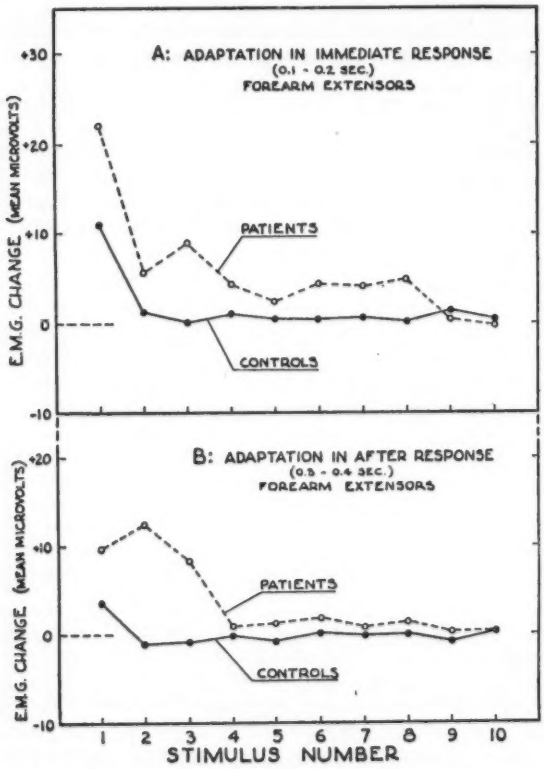

Figure 1. A. Comparison of patients and controls in forearm muscle potential reaction to a series of ten stimulations. These data are for the period immediately following stimulation.

B. Comparison of patients and controls in forearm muscle potential reaction to a series of ten stimulations. These data are for the third and fourth tenths of a second following stimulation.

Adaptation. During the course of each test the magnitude of response could be seen to diminish with succeeding stimuli in many subjects. This adaptation factor was dealt with as follows: mean microvolt change from pre-stimulus level was worked out for the immediate response period of 0.1 to 0.2 seconds (see Figure 1A), and also for the after-response period of 0.3 to 0.4 seconds (see Figure 1B), following stimulus. These data were plotted serially for the ten stimuli of the test. It was observed that by the fifth stimulus most responses had diminished to a very low level, and we considered that adaptation effects were strong enough to warrant the separate statistical treatment of early and late stimuli. Accordingly, the data were fractionated for separate analysis of the first four and the last six stimuli. In support of the appropriateness of this cut-off point, a tally of eyeblink responses showed that in the first four stimuli 80 per cent of controls' and 95 per cent of patients' responses were accompanied by the blink reflex, whereas the figures for the last six stimuli were only 52 per cent in controls and 75 per cent in patients.

Response pattern. Figure 2 shows curves of median amplitude in microvolts for the psychoneurotic and control groups for the first four stimuli. The group difference in initial tension level before the stimulus was not

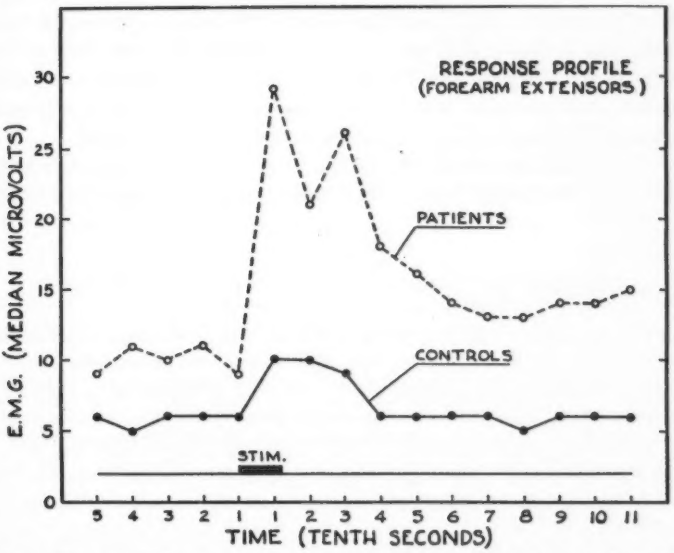

FIGURE 2. Comparison of patients and controls in forearm muscle potential amplitude for each tenth-second preceding and following stimulation. Each point on the curve is based on the averaged data from the first four stimulations.

significant. The analysis of the responses in these curves was carried out on the basis of EMG change in microvolts from mean pre-stimulus level. At 0.1 seconds both groups showed increase of tension, controls showing the less pronounced rise. The response of the "anxiety" patients was significantly higher than that of the controls (5 per cent level of confidence). At 0.2 seconds the response of the patients remained significantly higher than that of the controls. By 0.3 seconds the controls' response had started to fall off, but the response of the psychoneurotics showed a secondary rise, so that the patient-control difference at this point rose in reliability to the 1 per cent level. At 0.4 seconds the tension of the control group was back to normal, while that of the patient group was still elevated, though falling; the group difference was still significant at the 1 per cent level. At 0.5 seconds the difference was significant at 2 per cent, and by 0.6 seconds the difference, though visible in the median curve, was no longer significant.

Table I gives the p values for patient-control differences in each tenth-second following the onset of stimulus, worked out for the first four, the last six, and all ten stimuli combined.

To cover the possibility that there might be some relation between background tension and amount of response, the percentage of change with respect to pre-stimulus tension was also used as a measure. In this analysis the group differences are also present, but are not quite as significant statistically. The "anxiety" patients had significantly higher responses at 0.3 seconds than did the controls (5 per cent level) and at 0.4 seconds the significance increased to the 1 per cent level.

Intermuscle comparisons. As stated, there were no significant patient-control differences for sternomastoid and masseter muscles, whereas

TABLE I

RELIABILITY OF DIFFERENCES BETWEEN PATIENTS AND CONTROLS IN FOREARM MUSCLE POTENTIAL REACTIONS

	Time since onset of stimulation in seconds									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	p-values for patient-control differences									
Stimuli 1–4	.05	.05	.01	.01	.02	*	*	*	*	*
Stimuli 5–10	*	*	*	*	*	*	*	*	*	*
All 10 stimuli	*	*	.01	.01	.02	.05	*	*	*	*

*No significant differences.

there were for forearm extensor. The next step in the statistical analysis was to determine whether the difference between patients and controls was, in fact, reliably greater in the case of the forearm muscle than in the case of the head muscles. Statistical analysis showed that the patient-control difference for forearm was reliably greater ($p<.02$) than sternomastoid. The difference between forearm and masseter was in the same direction, but was not reliable statistically.

Following up this analysis, we undertook to determine whether the larger patient-control difference for forearm than for sternomastoid was due to some difference in patients (from muscle to muscle) or whether the difference was in the controls. Analysis revealed that it was the latter. Controls showed what we may call a spatial gradient, reacting more strongly with head muscles than with forearm muscles. Patients, on the other hand, were more diffuse in reaction and failed to show a clear gradient of this kind. In controls the sternomastoid reaction was very significantly greater than the forearm muscle reaction ($p<.01$). In patients there was no significant difference.

It should be especially noted that these differences were found only in the data for 0.4 seconds following stimulation. There were no reliable differences for either earlier or later intervals.

Schizophrenic group. Little of special interest was found in the data from this group. Variance in all dimensions (patient to patient, stimulus to stimulus) was so high as to make both the adaptation data and the response-pattern data of borderline reliability. In general, the results correspond with those for the psychoneurotics. The immediate response at 0.1 to 0.2 seconds was higher than for controls, but not significantly so. An after-response appeared at 0.4 to 0.5 seconds which was significant at the 5 per cent level.

Discussion

In view of the abandonment of the induced tension technique, it was not surprising to find that both patients and controls had pre-stimulus tension levels less than 50 per cent of those observed in the first series.

However, a comparison of the response patterns obtained in the two studies revealed some major differences which deserve comment. Patients and controls under the conditions of induced tension and long tone (Series I) gave about equal immediate responses (0.1 – 0.2 seconds), whereas under the conditions of no induced tension and very brief noise stimulus (Series II) this immediate response was much higher for the patient group than for the control group. The possibility that this difference in results is related to the change in method of measurement, rather than the change in the nature of the stimulus, is more or less ruled out by

the fact that the response patterns of the controls were almost the same in the two studies.

Perhaps the most important common finding in the two studies was the delayed elevation of tension which occurred at 0.4 seconds in the "anxiety" group, after the control group's tension had returned nearly to base line. It is interesting to note that in the early study, where the stimulus was of long duration, this late or after-response was quite prolonged, subsiding slowly from its peak during the first full second of stimulation. In the present study, with its brief stimulus, the after-response subsided rapidly, reaching normal tension levels by 0.6 seconds.

A very noticeable difference in the results of the two studies is that in the first series a high proportion of the after-responses were of greater amplitude than the immediate responses, whereas the reverse is true of the second series. This is probably due, in part, to the absence of induced tension; but the reduced intensity and duration of the stimulus must also play a part. Stimulus intensity in the present experiment must have been marginal for producing the startle pattern of Landis and Hunt (3), since only 83 per cent of patients' responses and 63 per cent of controls' responses were accompanied by the eyeblink reaction.

The strong statistical evidence in the present study for the presence of an abnormal after-response in the response pattern of psychoneurotic patients supports our earlier findings. These are upheld in spite of the lower stimulus intensity and the abandonment of the "induced tension" situation.

The generally less significant results in the schizophrenic group may be a matter of variance, or it may be that their responses were more heterogeneous. However, on the average, the schizophrenic group reacted more like the neurotics than the controls. The observed differences would support the findings of Malmo and Shagass (4) that non-deteriorated schizophrenics react in much the same way as severe cases of "anxiety" to stimulation of this kind.

There were almost no significant patient-control differences in the masseter and sternomastoid responses. This was not due to absence of response in these muscles, for both showed definite changes in most subjects. The absence of patient-control differences in the muscles of the head was not a negative finding as it at first appeared, for intermuscle comparisons showed that the response was less fully evoked in the arm muscles than in the head for normal controls (as would be predicted from Landis and Hunt (3, chap. 3)), whereas in the patients strength of evocation was nearly equal in all muscles.

We believe that it is proper to consider our data (albeit cautiously) within the framework of the startle pattern. While the less intense

stimulus employed in the present study may not have elicited the startle reflex in full force, some startle effect was present, in the initial trials at least. Furthermore, the more intense stimulation of the first study produced definite startle effects. Landis and Hunt give full details on the normal startle reaction, and they emphasize two aspects—the temporal course and the bodily distribution of the response. It is interesting to note how habituation or adaptation affects these two aspects of the pattern: Landis and Hunt showed that the later components of the response "adapt out" first, while the immediate components are much more resistant to habituation; also the responses in the limbs and trunk are much more readily adapted out than those of the head. Thus one might say that the immediate reaction is primary, in contrast to the after-response, which is secondary. Similarly, eyeblink and head movement may be considered primary as compared with arm movement.

Now, in view of our findings (1) that after-response differentiates patients from controls better than does immediate response, and (2) that arm response differentiates better than head response, the following generalization seems reasonable: There are larger and more reliable differences between patients and controls in the secondary or more peripheral components of the startle reaction than in what may be called the primary components.

Summary

1. The present study is a follow-up of a previous one which demonstrated that EMG responses to auditory stimulation differ in psychoneurotic patients and controls. A modified technique, employing weaker and briefer stimuli, was used. The EMG responses from masseter, sternomastoid, and forearm extensors were studied in groups of controls, "anxiety" patients, and schizophrenics. No induced tension was used.

2. Masseter and sternomastoid reactions did not differentiate between patients and controls.

3. Heterogeneity of response patterns in the schizophrenic group seemed mainly responsible for the absence of significant differences between these patients and controls.

4. In forearm extensors, "anxiety" patients showed larger initial responses than controls, but the most significant patient-control differences occurred at 0.3 to 0.4 seconds after stimulus, when controls' responses had almost subsided. This verified our earlier finding that psychoneurotics showed an abnormal after-response, following the initial reflex response to auditory stimulation.

5. The observations (*a*) that better patient-control differentiation was found in the after-response than in the immediate reflex reaction and

(*b*) that arm muscles showed more significant differences than head muscles are interpreted as two facets of the same general principle: there is less deviation (from normal) in psychoneurotics' primary startle reflex reaction than in secondary aspects of the total reaction mechanism.

REFERENCES

1. DAVIS, J. F. *A manual of surface electromyography.* Montreal: Laboratory for Psychological Studies, Allan Memorial Institute of Psychiatry, McGill University, 1952 (mimeo.).
2. DAVIS, R. C. Motor effects of strong auditory stimuli. *J. exper. Psychol.*, 1948, **38**, 257–275.
3. LANDIS, C., & HUNT, W. A. *The startle pattern.* New York: Farrar and Rinehart, 1939.
4. MALMO, R. B., & SHAGASS, C. Physiologic studies of reaction to stress in anxiety and early schizophrenia. *Psychosom. Med.*, 1949, **11**, 9–24.
5. MALMO, R. B., SHAGASS, C., & DAVIS, J. F. A method for the investigation of somatic response mechanisms in psychoneurosis. *Science*, 1950, **112**, 325–328.
6. SHAGASS, C., & MALMO, R. B. Response to intravenous sodium amytal as a quantitative indicator of tension in psychiatric patients. *Canad. Physiol. Soc. Proc.*, 1952, **16**, 59–60.
7. STEVENS, S. S., & DAVIS, H. *Hearing, its psychology and physiology.* New York: John Wiley and Sons, 1938.
8. WILCOXON, F. Individual comparisons by ranking methods. *Biometric Bull.*, 1945, **1**, 80–82.

EXPANSION OF THE JOURNAL

In the issue of March, 1954, the Publications Committee gratefully acknowledged a donation of $1,000 from the Aquinas Fund of New York to be used for the development and expansion of this journal. Since then the National Research Council of Canada has made us a grant of $400 for the same purposes.

The Annual Meeting of the CPA in June was informed of these generous gifts, and at the same time of a rather sharp increase in the cost of publishing the *Journal*. The meeting adopted the policy that any additional publication costs must be met out of general revenue, and that the donations should be used to increase the size of regular issues from 48 to 64 pages. This expansion went into effect with the September, 1954, issue, and can be maintained, under present conditions, until the end of 1955. By that time it is hoped that the improvement of the *Journal* will produce enough new subscriptions to enable us to carry on. We again thank those who have come to our aid in such timely and practical fashion.

D. C. WILLIAMS
Chairman, Publications Committee

PSYCHOMETRIC DIFFERENCES BETWEEN SENILE DEMENTIA AND NORMAL SENESCENT DECLINE[1]

HERBERT DÖRKEN JR.[2]
Verdun Protestant Hospital, Montreal

WHILE the literature on senescent decline and problems associated with old age is voluminous (17, 21, 30), little attention has been paid to the non-dementing psychoses of old age (18, 32). Toxic disorders, early cases of cerebral arteriosclerosis, and in particular the functional disorders of old age, are amenable to treatment, and in general respond more favourably than the senile dementias, where the course is usually one of progressive deterioration. Although he was stressing a broad relationship of age to recovery from psychosis, Clow (as reviewed by Granick, 22) was nonetheless able to state of individuals over 60 years of age: "The organic disturbances showed little improvement, but the functional disorders, particularly the manic-depressives, tended to recover." Not only do they recover following electro-shock treatment and other forms of therapy, but a significant number recover spontaneously. Since these nosological entities are comparable in age, the different response to treatment, or rather the general failure to respond favourably in senile dementia, does not seem purely attributable to the state of old age.

In spite of the absence of clear-cut qualitative neuro-anatomical differences in the brain between normal old age and senile dementia, most authorities hold to the view that further research will demonstrate an essential difference between the two states, and that the dementia may be due to a disease process (4, pp. 212–214; 26, pp. 1100–1105; 29, pp. 88–90; 38, pp. 597–599, 40). Runge (38) states that on the basis of evidence to date we are obliged to accept the findings that in senile dementia there is a distinct increase in anatomical changes of a type similar to those found in the brains of normal old people, but that no qualitative differences in this respect have been demonstrated.

Neither does the electroencephalograph appear to offer any clear-cut distinction between aging and dementia (10, p. 263). The biochemical studies of Lovett Doust *et al.* (31), however, show that the extent of senile dementia exists physiologically along a spectrum of progressive

[1]Presented at the annual meeting of the Psychological Association of the Province of Quebec, Montreal, Nov. 1953.

[2]Thanks are extended to Dr. George E. Reed, medical superintendent, Verdun Protestant Hospital, for his kind cooperation and permission to publish.

anoxemia, and further, that no correlation could be established between their oximetric results and chronological age.

The author holds to the view that senile dementia is essentially different from, or independent of, "normal senescent decline," and that, in contrast to the latter, the former does not correlate with age (save that it generally occurs in the *senium*) and is probably a disease process rather than a physiological condition (**14, 15**). The following survey of papers based on Wechsler-Bellevue (**41**) and Rorschach (**27, 37**) findings will attempt to illustrate this viewpoint, which has considerable bearing on the study (gerontology) and treatment (geriatrics) of psychiatric disorders in old age.

Normal Senescent Decline

The "Curve of Mental Growth and Decline" reported by Wechsler is similar to the curves of Miles and Jones and Conrad, and has clearly established that mental ability is not constant. "The point at which the falling off begins and the rate at which it progresses will vary from test to test and cannot be fixed . . . For most intelligence scales the differences between ages 15 and 25 are for most practical purposes negligible, but above that age the decline becomes appreciable and increasingly important. After 35 they begin to decrease so fast that the use of a single denominator for calculating I.Q.s for adults will introduce serious errors" (**41**, pp. 29–30). It was on this basis that Wechsler established different norms for each age-group, so that an individual throughout life will maintain, under ideal conditions, his same relative intellectual position, thus lending a statistical constancy to the I.Q. In agreement with the Babcock hypothesis (**1**), he found a differential rate of decline among his subtests, and on this basis established his Deterioration Index (**41**; **42**, pp. 43–52), derived from four subtests which "hold" with age and four which "don't hold." More recently, Copple (**11**) devised a Senescent Decline Quotient, based on correlational analyses of Wechsler-Bellevue data, which yields a maximum measurement of loss with age. It has been clearly shown, (**6, 11, 15, 19**) that this formula is an improvement over Wechsler's Index. The main fact, however, is that a statistically significant and readily demonstrable loss of psychometric mental ability is correlated with age. This has been shown in many studies (**17, 21, 30, 33**).

One factor which seems to have a definite influence on the rate of decline is the basic intelligence of the subject. The higher the intelligence the less is the decline (**17, 23, 33**). It is among the less intelligent (below average) that the normal decline with age of both intelligence and personality resources is most pronounced (**39**).

In keeping with the decline of mental ability, changes in personality

with advancing age have been reported. A characteristic personality structure has been found which changes from one developmental stage to the next (12): pre-adolescents often show a great deal of constriction and rigidity, characteristic of the latency period; adolescents show a marked swing toward introversion, and the adult years are characterized by a general expansiveness, with an introversive swing reappearing around the middle forties. In normal old age, typical Rorschach findings demonstrate a reduction of productivity, a narrowing of the range of interests and of the personality resources, with diminished creativity and emotional responsiveness, and a more rigid and inflexible mental set (8, 12, 23, 28, 35). Intellectual control, as it applies to personality, is also found to deteriorate, and there is often a concomitant vagueness.

That intelligence has a decided bearing on personality changes attributable to age is clearly demonstrated by Gurvitz (23). He found that persons of superior intelligence retained their personality integration relatively intact to the 50- to 54-year age level. Those of average intelligence showed moderate personality changes between the ages of 20 and 54, but persons of lower intelligence underwent "profound personality changes on reaching the 50 to 54 year age level . . . as well as a tremendous diminishment of performance in general."

Conversely, there have been a number of discussions on the reaction of an aged subject to his intellectual deterioration, and his adjustment to diminished intellectual capacity. General psychiatric opinion maintains that a stable occupational, social, and familial history, the presence of devoted relatives, and a well balanced personality structure, are factors which serve to minimize the effects of the decline of ability with advancing age. Though there is some suggestion of a relationship between life experiences and the development of emotional disorders in old age (22), this phase of gerontology has received little strict investigation, especially as regards the senile dementias. Pinkerton and Kelly (34), however, have followed this approach in attempting to evaluate the emotional reactions of a patient to his dementia.

Differentiation of Dementia from Senescence

Loss of previously well established habits, break in contact with reality, inability to integrate new events or shift behaviour, test behaviour *per se*, and other clinical distinctions of senile dementia from normal senescent decline are not within the scope of the present paper. The problems involved in testing and the interpretation of test results have been discussed at length in numerous publications (e.g. 24, 34). Suffice it to say that dementia imposes certain requirements on test administration procedures if optimal performance is to be elicited. Preparatory interviews,

encouragement during testing, and brief testing periods are mandatory (34).

Rabin (36) reports that the performance tests of the Wechsler Scale show consistent and significantly larger negative correlations with age than the verbal tests; however, the highest value he obtained was only −.32. Similarly, Halstead (24) considered a correlation of −.268 between scores on the full scale and age as indicating a more rapid decline of functions in old age. Others (8) report a low positive correlation (approximately .28) between chronological age and the Deterioration Index. While these studies purport to show that age and extent of dementia are related, they do not seem conclusive. Notwithstanding the statements of Wechsler (41) that the deterioration in normal old people is similar to that met with in most organic brain diseases, and of Hunt (25, pp. 971-989) that the Wechsler pattern of "psychological deficit in the aged resembles the pattern found in the organic psychoses," more recent studies (14, 15) conclude that the "process of senile deterioration, though rarely occurring until the age of the climacteric, bears no necessary close relationship with the normal process of aging." Since the ages of mildly, moderately, and severely demented senile groups did not differ, and since correlations between intellectual capacity and age were but +.101 and −.162 (N = 30 and 67, respectively), it was considered that the observable decline of mental ability with age among normal individuals can no longer be demonstrated in senile dementia.

It might be objected that dementia so reduces the ability to understand test instructions, to attend to and concentrate on the test items, that a minimal performance is elicited regardless of age (and that therefore little correlation of performance and age is to be expected). The fact remains, however that it is the state of dementia which has reduced this ability. Then too, if such subjects are grouped clinically according to degree of dementia, no correlation with age will be evident (34).

Though the group patterns of dementia and senescence on Wechsler's test present superficial similarities, the extensive individual variations show that the pattern of senescent decline is seriously lacking in stability (9, 14, 15). While there is a differential rate of decline among the subtests (20), this selective destruction of various intellectual functions exists as a statistical mean for the group rather than as an individual test phenomenon; the selectivity is far from uniform. Correlational studies show that with senile dementia there is a reorganization of abilities (marked changes in inter-subtest correlations) as compared with that found in normal adulthood (15, 16); hence it seems likely that the separate tests may not describe the same intellectual functions from age

to age (2, 16). In senile dementia, the intercorrelations among the Wechsler subtests become surprisingly high, averaging +.63 (5). Factor analysis shows distinctly lower scores for senile dementia than for normal old age, a fact which Birren attributes to a deficit factor induced by brain disease. Thus, rather than obtaining measurements of a variety of intellectual capacities, we are left with a generalized impression of severe loss, statistically reflected, and due to senile dementia. This heightened "internal consistency" might in itself be a measure of the extent to which the thought processes have been disintegrated by the pathological process (13).

"Resistance to decline" is a characteristic of normal change with age that can be demonstrated for all Wechsler-Bellevue subtests (13). Berkowitz has shown that the decrease in intellectual efficiency during the 20 years preceding age 60 is greater than any decrease in efficiency during the 20 years following age 60. In the event of senile dementia, however, it is evident that such a resistance to further decline would no longer be in effect.

A marked reduction in test scores with dementia can readily be demonstrated (9, 15, 24, 36), particularly in performance tests. Rabin (36), in a study of individuals over 60 years of age, showed that there was a considerable difference between mean subtest scores of senile, arteriosclerotic, miscellaneous psychotic, and non-psychotic groups. However, since the rank order of the subtests remained similar throughout the groups, he considered that the findings were more typical of the age level than of the psychosis represented. Botwinick and Birren (7) also found that the mean scores of the subtests were lower for their senile psychotic than for their control group, but made a neat and essential distinction between the two. They point out that: "The tests which showed the greatest decline due to normal aging were not necessarily the tests which showed the largest difference between the groups. Thus, the susceptibility of a subtest to age decline does not seem to determine the ability of the subtest to differentiate between control and senile psychotic populations." Whereas, "If deterioration in the senile psychoses were essentially a process of accelerated aging, the subtests which show the largest age changes might be expected to show the largest differences between the two groups" (6). Further, their data suggest that Wechsler's Deterioration Quotient would not be equally sensitive both to states of normal age decline and to senile psychotic deterioration. Hence the difference between these two states is not merely a quantitative one, one of degree, but also a qualitative one; the dementia is essentially different from the normal age decline. Comparison with the performance of

children (34) or mental defectives (14) shows that senile dementia is not purely a regression, i.e., a quantitative phenomenon, but that qualitative differences exist between all three groups.

Detailed analysis of the Rorschach records of cases of senile dementia reveals but few trends related to age only (14); this is in distinct contrast to the age factor evident in the records of normal old people (23). While it is usual in senescence for the personality to regress to a level resembling that of early adolescence (12, 28, 35), senile dementia introduces the qualitative changes of organic deterioration (14). With advanced dementia the trends of age decline are disrupted, particularly in regard to emotional responsiveness, manner of approach, and nature of the thought content. Instead of the narrowing of the personality resources seen in senescence, there is in senile dementia a loss of function, with consequent inability to maintain the controls and produce the expressions that previously distinguished the individual personality.

Summary

A large number of psychological investigations clearly established that there is a decline both of test intelligence and of personality resources in normal old age. In contrast to the contention of a number of authors that senile dementia is but a more advanced condition of the state of normal old age, it can be demonstrated by psychological tests that senile dementia is qualitatively, as well as quantitatively, different from the normal senescent decline, is independent of it, and probably superimposed on it. The distinction of senile dementia from normal senescent decline is particularly relevant in view of the need for closer attention to the non-dementing psychoses of old age.

REFERENCES

1. Babcock, Harriet, & Levy, L. *Measurement of efficiency of mental functioning: revised examination.* Chicago: Stoelting, 1940.
2. Balinsky, B. An analysis of the mental factors of various age groups from 9 to 60. *Genet. Psychol. Monogr.*, 1941, **23**, 191–239.
3. Berkowitz, B. The Wechsler-Bellevue performance of white males past age 50. *J. Geront.*, 1953, **8**, 76–80.
4. Biggart, J. H. *Pathology of the nervous system.* Edinburgh: E. & S. Livingstone, 1936.
5. Birren, J. A factorial analysis of the Wechsler-Bellevue Scale given to an elderly population. *J. consult. Psychol.*, 1952, **16**, 399–405.
6. Botwinick, J., & Birren, J. The measurement of intellectual decline in the senile psychoses. *J. consult. Psychol.*, 1951, **15**, 145–150.
7. Botwinick, J., & Birren, J. Differential decline in the Wechsler-Bellevue subtests in the senile psychoses. *J. Geront.*, 1951, **6**, 365–368.

8. Chesrow, E., Wosika, P., & Reinitz, A. A psychometric evaluation of aged white males. *Geriatrics*, 1949, **4**, 169–177.
9. Cleveland, S., & Dysinger, D. Mental deterioration in senile psychosis. *J. abnorm. soc. Psychol.*, 1944, **39**, 368–372.
10. Cohn, R. *Clinical electroencephalography*. New York: McGraw-Hill, 1949.
11. Copple, G. Senescent decline on the Wechsler-Bellevue Intelligence Scale. *Univ. Pittsburgh Bull.*, 1949, **45**, 227–236.
12. Davidson, Helen, & Kruglov, Lorraine. Personality characteristics of the institutionalized aged. *J. consult. Psychol.*, 1952, **16**, 5–12.
13. Dörken, H., jr. Projective tests and the consistency of the personality structure: a pilot study. *J. abnorm. soc. Psychol.*, 1953, **48**, 525–531.
14. Dörken, H. jr., & Kral, V. A. Psychological investigation of senile dementia. *Geriatrics*, 1951, **6**, 151–163.
15. Dörken, H., jr., & Greenbloom, Grace. Psychological investigation of senile dementia: II. The Wechsler-Bellevue Adult Intelligence Scale. *Geriatrics*, 1953, **8**, 324–333.
16. Eysenck, M. An exploratory study of mental organization in senility. *J. Neurol. Neurosurg. & Psychiat.*, 1945, **8**, 15–21.
17. Eysenck, M. The psychological aspects of aging and senility. *J. ment. Sci.*, 1946, **92**, 171–181.
18. Forster, W. The aged mental hospital patient. *J. Can. Med. Ass.*, 1953, **68**, 29–33.
19. Fox, Charlotte, & Birren, J. The measurement of intellectual deterioration in the aged. *Amer. Psychol.*, 1950, **5**, 364 (abstract).
20. Fox, Charlotte, & Birren, J. The differential decline of subtest scores of the Wechsler-Bellevue Intelligence Scale in 60–69-year-old individuals. *J. Genet. Psychol.*, 1950, **77**, 313–317.
21. Granick, S. Studies in the psychology of senility: a survey. *J. Geront.*, 1950, **5**, 44–58.
22. Granick, S. Studies of psychopathology in later maturity—a review. *J. Geront.*, 1950, **5**, 361–369.
23. Gurvitz, M. Personality and intellectual correlates of the aging process as measured by the Rorschach Technique. *Amer. Psychol.*, 1953, **8**, 360 (abstract).
24. Halstead, H. A psychometric study of senility. *J. ment. Sci.* 1943, **89**, 363–373.
25. Hunt, J. McV., & Cofer, C. *Personality and the behavior disorders*, Vol. II. New York: Ronald Press, 1944.
26. Jelliffe, S. E., & White, W. A. *Diseases of the nervous system: a text book of neurology and psychiatry*. Philadelphia: Lea & Febiger, 1935.
27. Klopfer, B., & Kelley, D. *The Rorschach technique*. New York: World Book, 1942.
28. Klopfer, W. Personality patterns of old age. *Ror. Res. Exch.*, 1946, **10**, 145–166.
29. Lichtenstein, B. *A textbook of neuropathology: with clinical, anatomical and technical supplements*. Philadelphia: W. B. Saunders, 1949.
30. Lorge, I. Intellectual changes during maturity and old age. *Rev. educ. Res.*, 1947, **17**, 326–332.
31. Lovett Doust, J. W., *et al.* Studies on the physiology of awareness. The correlation between intelligence and anoxemia in senile dementia. *J. nerv. ment. Dis.*, 1953, **117**, 383–398.

32. MADDEN, J., *et al.* Non dementing psychoses in older persons. *J. Amer. Med. Ass.*, 1952, **150**, 1567–1570.
33. NYSSEN, R. & DELYS, L. Contribution à l'étude du problème du declin intellectuel en fonction de l'âge. *Arch. Psychol.*, 1952, **33**, 295–310.
34. PINKERTON, P., & KELLY, J. An attempted correlation between clinical and psychometric findings in senile-arterio-sclerotic dementia. *J. ment. Sci.*, 1952, **98**, 244–255.
35. PRADOS, M., & FRIED, E. Personality structure of the older age groups. *J. clin. Psychol.*, 1947, **3**, 113–120.
36. RABIN, A. Psychometric trends in senility and psychoses of the senium. *J. gen. Psychol.*, 1949, **32**, 149–162.
37. RORSCHACH, H. *Psychodiagnostics.* Berne: Huber, 1942.
38. RUNGE, W. Die Geistesstörungen des Greisenalters: I. Die physiologischen Erscheinungen des Greisenalters. In O. Bumke (Ed.), *Handbuch der Geisteskrankheiten*, Vol. VIII. Berlin: Julius Springer, 1930.
39. SHOCK, N. Gerontology (later maturity). *Ann. Rev. Psychol.*, 1951, **2**, 353–370.
40. STERN, K., & REED, G. Presenile dementia (Alzheimer's Disease). Its pathogenesis and classification. *Amer. J. Psychiat.*, 1945, **102**, 191–197.
41. WECHSLER, D. *The measurement of adult intelligence.* Baltimore: Williams & Wilkins, 1944.
42. WECHSLER, D., & SHAKOW, D. *Intellectual changes with age.* Washington: Publ. Hlth. Rep., 1942, No. 168.

A STUDY OF ANXIETY IN A GENERAL HOSPITAL SETTING[1]

MORGAN W. WRIGHT
Medical Arts Clinic, Regina

Two approaches can be distinguished in current psychological research on anxiety. The first is centred in the clinical method, where the performance of a group of anxiety neurotics on specified tasks is compared with that of a control group of normals or a group of neurotics of another psychiatric category. The second approach involves the inducement of anxiety in a controlled laboratory situation; the subject's performance on selected tests being compared before and after threat. These two techniques have been criticized in Hanfmann's (5) review of the literature on the grounds that in the first method it is difficult to educe from a psychiatric category the degree of anxiety presently experienced by the subject, and that in the second it is not known how the subject perceives the introduced threat; i.e. whether he becomes truly anxious or not. These difficulties, the above reviewer believes, may explain the sometimes contradictory results reported.

The present research attempts to meet these criticisms. Two types of anxiety are postulated: anxiety attributable to a present stress situation (hereafter termed situational or normal anxiety), and anxiety arising from a generally unstable adjustment to the environment (to be called basic or abnormal anxiety). Basic anxiety differs from situational in that it is chronic. Although a stress situation may intensify its expression, basic anxiety is assumed to be present even without stress, since it is a constant feature of the "personality."

The research was conducted in the public surgical wards of a large general hospital, with the anxiety cue being the patient's expectation of an imminent surgical operation. It was felt that such a setting provided the opportunity for combining the realism of the clinical approach with the control of the experimental. The method was to select 14 abnormally anxious patients and 14 normally anxious patients, and test them before and after surgery. It was anticipated that a comparison of performance before and after operation would yield data pertinent to situational anxiety; whereas a comparison between the two selected groups prior

[1]This is an abridged version of a thesis submitted in 1952 in partial fulfilment of the requirements for the degree of Doctor of Philosophy in the Department of Psychology, University of Toronto. I wish to thank Dr. Everett Bovard for his assistance with the work.

to the operation would provide insight into the influence of basic anxiety on test performance. This latter comparison would be valid only if the two groups were comparable on pertinent indices other than anxiety, and if the operations (stress) for the two groups were of equal severity.

The general hypothesis directing this investigation was that the psychological manifestations of anxiety could be understood as a "defence reaction," a means of protecting the psychological integrity of the individual faced with the unknown outcome of an impending surgical operation. Specifically it was predicted that anxious subjects would:

(1) be less empathic, the assumption being that the negative reaction to anxiety involves a decrease in social participation;

(2) be more conceptually rigid, reflecting the need to depersonalize their thinking and inhibit personal spontaneity;

(3) be more rigid in the performance of a visuo-motor task, indicative of a cautious, egocentric approach to reality;

(4) have a smaller attention span, suggesting the need to narrow or delimit attention;

(5) be less productive associationally, reflecting an intra-psychic rigidity due to a fear of spontaneity.

Selection of Basically and Normally Anxious Subjects

The total population from which the two above groups were selected comprised the patients awaiting operation in the three public wards of the Toronto General Hospital. The actual process of the selection can be divided into two steps.

First, in each ward the doctors and nurses were asked to name patients who were clearly (*a*) abnormally, or (*b*) normally, anxious prior to operation. Cases were then excluded if there was neurological involvement, or if the operation was likely to be inconclusive (e.g., cancer patients). Likewise those patients whose pre-operative period was likely to be painful, or who for any other reason were under heavy sedation, were not included.

Second, those patients who still qualified were interviewed by the author and rated by him on a check list of 18 symptoms commonly associated with anxiety (Table I). If the subject was preselected as being abnormally (basically) anxious, but did not test "anxious" on the check list (5 anxiety symptoms present), he was dropped. Similarly, patients selected as normally (situationally) anxious were dropped if they made a score of 5 or more on the anxiety check list. It was thus possible to ensure that the results of the anxiety check list were consistent with the observations of other people who had knowledge of the patient.

As will be noted, 12 of the 18 items relate directly to heightened

TABLE I

ANXIETY CHECK LIST

1. Cold and/or damp hands	10. Nausea, appetite poor, loss of weight
2. Perspires freely	11. Overly concerned about operation
3. Tremor of hands, lips or tongue	12. Speaks very quickly
4. Body tenseness or rigidity	13. Constantly seeks attention, needs encouragement
5. Overly fast reflexes, initially resists passive flexion or extension	14. Finds it hard to concentrate
6. Voice uneven or edgy	15. Diarrhoea or constipation
7. Strained expression on face	16. Impresses as being anxious
8. Has nightmares or bad dreams	17. Overly timid or hostile
9. Sleeps poorly, may take sedatives	18. Urinates frequently

sympathetic autonomic activity (sweating, tremor, body tenseness, nausea, etc.), two to the hospital experience, and the remaining four to the patient's general adjustment—whether he finds it difficult to concentrate in hospital, has nightmares, is overly timid or hostile, or whether he just "impresses as being anxious." With respect to rating, the condition of the patient can be objectively determined on five of the items (e.g., whether he is sweating or not); six involve information from the patient (e.g., whether he feels nauseated much of the time); and the remaining seven are assessed by the investigator (e.g., whether the patient seems unusually timid or hostile).

The mean number of items checked for the abnormally anxious group was 7.8 symptoms.

For the normal group, the mean was 1.07. This is admittedly a very low figure; however, each patient did express concern about the operation. Those patients who appeared totally bland or indifferent were not included, as it was felt that they might form another group of basically anxious subjects.

SITUATIONAL CONTROLS

Each operation was assessed by the resident surgeon as simple, moderately serious, or serious. The distribution of the ratings is as follows:[2]

	Simple	*Moderately serious*	*Serious*
Abnormally (basically) anxious	5	2	6
Normally (situationally) anxious	3	4	6

An inspection of the above table will show that the seriousness of the operation is roughly comparable for the groups, suggesting that the difference in anxiety reaction can be attributed to basic anxiety, not to a

[2]The operations of two patients could not be rated as the charts were not available.

disparity in the stress situation. Other characteristics of the two groups are shown in Table II. The mean time between testing and operation was 5 days for the basically anxious, and 6.4 for the normally anxious.

TABLE II

EQUIVALENCE OF BASICALLY AND NORMALLY ANXIOUS PATIENTS* IN RESPECT TO AGE, INTELLIGENCE, AND EDUCATION

	Age		Intelligence		Education	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Basically anxious subjects	29.4	9.47	93.1	13.2	8.53	1.95
Normally anxious subjects	27.7	9.26	93.2	16.3	8.46	2.27

*Each group comprising 2 men and 12 women.

MEASURING INSTRUMENTS

Five pairs of tests were administered before and after operation.

1. *Empathy.* Two series of six T.A.T. pictures were used to measure empathy. Series I was made up of cards 1, 2, 3BM, 4, 7GF, and 6BM; series II included 3GF, 6GF, 7BM, 8GF, 9GF, and 10. An objective method of scoring was devised by the author, based in part on Dymond's (3) work in this area. It involved assigning a numerical score to the description of each character in the story, the total score indicating the degree to which the subject ascribed thoughts and feelings to the various characters. The scoring was undertaken by two other psychologists, working from typed protocols with no identifying information; the rank-order correlation between their ratings was .826.

2. *Conceptual rigidity.* For the measurement of this variable, two equivalent forms of the ink blot series were used: the Rorschach and the Harrower (4). Only one aspect of the test was selected for measurement —the F% or percentage of pure form responses. Both tests were administered according to the Bühler (1) method in order that a "Basic Integration Coefficient" could be obtained.

3. *Visuo-motor rigidity.* The Wechsler-Hartog (9) mirror drawing test (Katoptograph test) was used for the measurement of visuo-motor rigidity. The score used was the time taken to connect five points viewed through a mirror, i.e., with the images reversed. In one group the preferred hand was used; in the other, the unpreferred hand.

4. *Attention span.* The digit span subtest of the Wechsler Bellevue (8) test of general intelligence was employed here. The score was the total raw score (number of digits repeated forward plus the number back-

ward). The alternate test was made up of the same digits in the reverse order.

5. *Associational productivity.* Two series of 14 uncompleted similes were drawn up by the investigator, based in part upon similar tests devised by de Martino (2) and Steer (7). The subject's task was to think of as many completions to a given uncompleted simile (e.g., "as angry as ——") as he could in a 30 second interval.

All tests were administered at the bedside, on a bed table especially made to fit across the patient's knees. Each test battery, pre- and post-operative, was given in two sessions. The first group included the Wechsler Bellevue (short form), Rorschach or Harrower, and six-card T.A.T. The second test session included the Katoptograph and Simile Association test. To offset the effects of not having exactly equivalent tests, both anxiety groups were split and one half given battery one and the other half battery two before operation, the reverse order being followed after the operation.

Results

Basic and normal anxiety. As may be seen in Table III, the basically anxious patients were, as compared with the normally anxious, less empathic, more conceptually rigid, and less associationally productive. These findings are consistent with the hypothesis that anxiety is associated with constriction of response. The other two variables did not reliably differentiate the two groups. However, since the unreliable differences did favour the hypothesis, it cannot be assumed that such differ-

TABLE III

Test Results of Basically Anxious and Normally Anxious Patients

(degrees of freedom = 26)

	Mean score of basically anxious patients	Mean score of normally anxious patients	*t* ratio	Significance
1. Empathy (T.A.T.)	13.42	17.82	2.95	.01
2. Conceptual rigidity (F%—Rorschach and Harrower)	47%	31%	3.579	.01
3. Visuo-motor rigidity (Katoptograph test)	130″	81″	1.438	.15
4. Attention span (W-B digit span)	9.3 digits	10.5 digits	1.715	.10
5. Associational productivity (simile association test)	20.35	41.0	4.714	.001

ences might not be found reliable in a study in which more subjects were utilized, or where matched rather than equated groups were used.

Situational anxiety. It was assumed that any difference between the test results before and after operation would be due to *situational* anxiety. This assumption is valid only if test adaptation or practice effect did not influence post-operative scores. In four of the five variables it was felt that such factors would have little influence on post-operative results. The one exception was visuo-motor rigidity as measured by the Katoptograph test. Practice effect here was checked by using a group of 27 university students who were given the same task in a group test situation, the time interval between first and second testing being 14 days (the time between pre- and post-operative testing was 24 days). The university students did show a significant improvement in their performance on the second testing.

No set time was predetermined for the post-operative testing. In each case the patient was tested as close to the date of departure from hospital as possible, when the results of his operation were reasonably certain and his mind was at rest. This varied from a matter of months, for the more serious operations, to a few days. The average for the total group was 16 days: 16.4 for the basically anxious, and 15.7 for the normally anxious.

The results, shown in Table IVA indicate that, following operation, the patient's attention span became greater, visuo-motor coordination improved, and conceptual rigidity decreased. This is in accord with the hypothesis. The improvement in visuo-motor coordination was significantly greater than the practice effect shown by the control group (see Table IVB). Contrary to expectation, there was no change in the empathy or associational productivity scores.

Discussion of Results

In general it can be concluded that anxiety, basic or situational, is associated with constriction of response, with two notable exceptions. It was found that situational anxiety did not influence the empathy or associational productivity scores.

An explanation for this in the case of empathy is found in its relatively high correlation with the Basic Integration Coefficient (r .756) obtained on the Rorschach and Harrower tests, a score which was also found to remain constant before and after operation, and is reputed to be a measure of a basic personality structure. The "empathy index," then, may be a measure of a stable personality variable which is not vulnerable to situational anxiety.

Associational productivity was not found to correlate significantly with

TABLE IV

A. Test Results Before and After Operation
(degrees of freedom = 27)

Variable	Mean scores		t ratio	Significance
	Pre-operative	Post-operative		
1. Empathy (T.A.T.)	15.62	15.14	—	—
2. Conceptual rigidity (F%—Rorschach and Harrower)	39%	32%	4.07	.01
3. Visuo-motor rigidity (Katoptograph test)	105″	59″	3.29	.01
4. Attention span (W-B digit span)	10.0	11.32	4.04	.01
5. Associational productivity (simile association test)	30.67	31.2	—	—

B. Comparison of Patients with Control Group on Test 3
(degrees of freedom = 53)

	Difference between means		t ratio	Significance
	Patients	Students		
3. Visuo-motor rigidity	46.4″	8.2″	2.911	.01

any of the experimental variables. However, the nature of the task sheds light on both its insensitivity to situational stress and its high differentiating value in distinguishing between the basically and normally anxious group. In this test the task is to associate a stimulus phrase with as many completions as possible in 30 seconds. For the normally anxious subject this is no serious challenge, since a stimulus phrase like "as interesting as" or "as painful as" is quickly related to things he has found interesting or has experienced as painful. For the basically anxious subject however, since he tends to stand off from experience (basic anxiety being synonymous with basic constriction), no such ready store of associations is available.

The two tests, empathy and associational productivity, though measuring different things, have this in common: they both involve past associational patterns. In the case of empathy the associations are interpersonal in character, reflecting the way in which the person habitually reacts to the feelings and needs of other selves. In associational pro-

ductivity the associations are intra-personal, being drawn, it is supposed, from the past experience of the subject, and indicating the extent to which he becomes "a part of all he meets." The fact that they did not shift significantly with situational stress is indicative of their stable, enduring character.

The other three variables differ from the above tests in that they present the patient with something new and less personally meaningful. In the digit-span subtest the subject must be able to concentrate on a series of digits in terms of presently given associations rather than fall back on established patterns. In the mirror-drawing test the subject is forced to perform in a way that is contradictory to expectancies based on past experience, an adjustment which appears to be interfered with by situational anxiety. The ink blot test (F%) also involves the subject in a task which denies the possibility of solution through the application of past habits and techniques. Herman Rorschach (6) believed that this variable on the Rorschach was the most responsive to conscious control. In this situation, the fact that the F% decreased after the operation is interpreted as indicating that when a subject is situationally anxious there is an attempt to strengthen control by depersonalizing the new and challenging, responding to the objective qualities of the blot rather than allowing the imagination full sway.

Thus, although constriction is found in both situational and basic anxiety, its manner of occurrence is different. One could conclude that basic anxiety interferes with fundamental patterns of social response. Situational anxiety, on the other hand, temporarily reduces the capacity to respond to new challenges which require unhampered concentration or novel adjustments. This can be understood if we think of basic anxiety as due to early unresolved situational anxiety, which, because of its chronic and constrictive character, has prevented the individual from developing with experience.

Summary

An attempt was made to measure anxiety in a realistic situation which offered the possibility of combining the clinical and experimental approaches. Two types of anxiety were identified: situational and basic. Situational anxiety appeared to interfere temporarily with the subject's ability to solve a new problem or adapt to a novel experience. Basic anxiety, on the other hand, was found to reduce the subject's ability to relate to people and to assimilate experience. Such a finding is consistent with the belief that basic anxiety early in life impairs the individual's orientation to reality by forcing him to develop a chronic self-protective adjustment which tends to insulate him from experience.

REFERENCES

1. Bühler, C., Bühler, K., & Lefever, D. W. *Rorschach Standardization Studies, No. 1. Development of the basic Rorschach score with manual of directions.* New York: Bühler, Bühler, & Lefever, 1945.
2. de Martino, M. F. The similes test as a group device. *J. clin. Psychol.*, 1947, 3, 164–168.
3. Dymond, Rosalind F. A preliminary investigation of the relations of insight and empathy. *J. consult. Psychol.*, 1948, 12, 228–233.
4. Harrower, M., & Steiner, M. F. *Psychodiagnostic ink blots.* New York: Grune & Stratton, 1945.
5. Hanfmann, E. Psychological approaches to the study of anxiety. Chapter IV in Hoch and Zubin (Eds.), *Anxiety.* New York: Grune & Stratton, 1950.
6. Rorschach, H. *Psychodiagnostics.* New York: Grune & Stratton, 1942, 66–70.
7. Steer, H. O. An investigation of the concept of self-definition. Unpublished doctor's dissertation, University of Toronto, 1951.
8. Wechsler, D. *The measurement of adult intelligence* (3rd Ed.). Baltimore: Williams & Wilkins, 1944.
9. Wechsler, D., & Hartogs, R. The clinical measurement of anxiety. *Psychiat. Quart.*, 1945, 19, 618–635.

THE RELATIONSHIP BETWEEN REVERSIBLE PERSPECTIVE AND EMBEDDED FIGURES[1]

P. LYNN NEWBIGGING
University of New Brunswick

BOTH the reversal of figures of reversible perspective and the finding of a simple geometric form in a complex one would seem to require the participation of non-sensory factors in the perceptual process. Gottschaldt (1), who first experimented with visual forms of the type where a simple form is contained or "embedded" in a complex one, demonstrated that mere repeated experience of the simple form does not result in its being perceived in the complex form when the latter is shown. He did note, however, that the chances of the simple form being perceived were enhanced when the subject adopted an active (search) attitude rather than a passive one (1, p. 113). Witkin (6) used some of Gottschaldt's figures with modifications (e.g., colouring of the complex figures in various ways) to investigate individual differences in the length of time required to find the simple figure when an active search attitude was adopted. He found that there are extensive individual differences, and that women as a group require a longer time than men.

Finding the simple figure would seem to depend on perceiving the relevant lines of the complex figure in different relationships to one another from those that apply when the complex figure is perceived as such. The process may be described as restructuring the perceptual field in subjective terms. Voth (5) suggests that reversing figures of reversible perspective depends upon an ability to "restructure the perceptual field more or less according to . . . subjective standards." Similarly, the lines of a reversible perspective figure must, when one perspective replaces the other, be seen in different relationships to one another.

In a previous paper (4) the writer attributed reversal of figures of reversible perspective to fluctuations of attention. And Hebb, in discussing figures of the type used by Gottschaldt, says in effect that attention and fluctuations of attention must be taken into account in order to understand the process by which a simple figure embedded in a complex one is perceived (2, pp. 24–25). These two somewhat different explana-

[1]Adapted from part of a thesis submitted in 1952 in fulfilment of the requirements for the degree of Doctor of Philosophy in the Department of Psychology, University College, London. I wish to thank Professor R. W. Russell and Mr. J. W. Whitfield for their assistance with the work.

tions may be made consistent by assuming that fluctuation of attention, which releases central processes from immediate sensory control, is a necessary antecedent to subjective restructuring of the perceptual field.[2]

If it is true that reversing figures of reversible perspective and perceiving simple figures embedded in complex ones are dependent upon the same factors, we would expect that those individuals who reverse figures of reversible perspective rapidly would require less time to perceive a simple figure in a complex one, and vice versa. The present experiment was designed to test this hypothesis.

Method

Five figures of reversible perspective and 13 complex geometric figures, each of which had one of five simple figures embedded in it, were presented to 52 subjects. The results obtained were then correlated.[3]

Subjects

Fifty-two university students, representing 12 departments, acted as subjects. Twenty-six of the group were male and 26 female. The subjects ranged from 17 to 32 (to nearest birthday) and the mean age was 21.

Reversible Perspective

The five figures of reversible perspective that were used, and the order in which they were presented to the subjects, were as follows: (1) reversible prism, (2) three reversible blocks, (3) Schroder's stair figure, (4) Necker's cube, (5) Beaunis' cubes. These figures were drawn in india ink to cover an area of approximately three square inches in the middle of a 4″ × 6″ white card.

The figures were exposed through an aperture in the middle of a 36″ × 32″ black screen. The procedure was to seat the subject at the end of a table, 41 inches from the screen. A lever-type key, connected to a magnetic counter, was placed convenient to his preferred hand. The counter and the experimenter were concealed behind the screen throughout the experiment. The experiment was conducted in a room in which the only source of illumination was a 100-watt overhead lamp. The screen was so arranged in relation to the light source that no shadow fell across the figures of reversible perspective when they were exposed through the aperture in the screen.

The subject was familiarized with the apparatus and the task. The first figure was used for this purpose. He was then instructed to try to reverse each subsequent figure as rapidly as he could and to close the key as each reversal occurred. Closing the key resulted in one being added to the total already registered on the counter.

---

[2]This hypothesis is elaborated in a paper now in preparation.

[3]Kendall's (3) rank order correlation methods were used for all statistical analysis reported in this paper. A feature of τ (tau) to be kept in mind is that its absolute magnitude may give a misleading impression of its significance. In comparing τ with Spearman's ρ (rho), Kendall makes the following statement: ". . . when neither coefficient is too close to $+1$ or -1, ρ is often about fifty per cent greater than τ in absolute value. The coefficients have, in fact, different scales, like the different scales of Centigrade and Fahrenheit thermometers. The differences emphasize . . . the importance of not attributing too much importance to the actual magnitude of a rank correlation" (3, p. 11).

A switch in the circuit containing the counter and the key permitted the former to be cut in or out at any desired moment. This was provided so that the counter could be cut into the circuit only after the subject had succeeded in reversing the exposed figure for the first time. Thus, at the occurrence of the first reversal, known to the experimenter by the distinctly audible click of the key, the counter was cut in and a stop watch started. After exactly 30 seconds the counter was cut out and the figure removed. This procedure of waiting for the first reversal before recording was adopted in an attempt to control differences between subjects in their experience of figures of reversible perspective. Some of the subjects had seen some of the figures before, while others had not. With the former, since they knew what to look for, the first reversal occurred fairly quickly, whereas with the latter it took somewhat longer. If no reversal occurred after any figure had been visible to the subject for one minute, that figure was removed and scored zero.

A record was kept of the number of times each figure was reversed. Data for the first and second figures were not included in the analysis, the first figure being used to familiarize the subject with the task, and the second to give him practice under experimental conditions. The total number of reversals of the last three figures constituted the subject's score.

Embedded Figures

The five simple and thirteen complex figures that were used formed five groups. The first group consisted of one simple and one complex figure and the remaining four groups consisted of one simple and three complex figures. In all groups, the simple figure was to be found in the complex figures grouped with it. All figures used were selected from those used by Witkin (**6**). The five simple figures were drawn in india ink on 4″ × 6″ cards. The complex figures were reproduced on ordinary absorbent duplicating paper. The paper was then cut so that each figure occupied the centre of a separate slip. Figure 1 is an example of a simple figure and one of the complex figures in which it is contained.

FIGURE 1. A simple figure and a complex one in which it is contained.

The procedure for this part of the experiment was to present the subject with a complex figure for 15 seconds, during which time he was required to describe it. The complex figure was then removed and a simple figure, which was contained in the complex one immediately preceding, was shown. At the end of 10 seconds this was removed and the complex figure returned. This time the subject was required to look at the complex figure, without making any tracing movements, until he saw the simple figure. He indicated this by saying "now," and then took up a red pencil placed conveniently near him and outlined the simple figure. The first group, consisting of one simple and one complex figure, was used for practice.

The purpose of having the subject describe the complex figure during its first presentation was to prevent him from searching for the simple figure during this

period. The simple–complex figure pairs were presented in such an order that no simple figure appeared in two successive pairs. The same order was maintained for all subjects. The time taken to find each simple figure was measured by a stopwatch to the nearest half-second, and was taken as the time between the presentation of the complex figure for the second time and the moment the subject said "now." The total time taken to find the simple figure in the twelve complex figures constituted the subject's score.

Results

Both the distribution of reversal scores and the distribution of the embedded figures scores were positively skewed. That is, relatively few reversals of the figures and a relatively short time for finding the embedded figures tended to be characteristic. The reversal scores ranged from 10 to 181 with Mdn = 36.8 and Q = 13. The embedded figures scores ranged from 41.5 to 1,234 (seconds) with Mdn = 241.5 and Q = 154.3.

In a previous paper by the writer (4) it was shown that three figures of reversible perspective probably give a reliable score. In the experiment there reported the reliability of the scores given by six figures was computed by the split-half method. The obtained correlation was $r = 0.82$. This indicates that the scores yielded by each group of three figures is fairly stable. The scores given by the three figures used in this experiment when intercorrelated gave an average correlation of $\tau = 0.47$ ($P < .01$). The reliability of the embedded figures scores was computed by the split-half method, which gave a coefficient of $\tau = 0.27$ ($P < .01$).

The two sets of scores were correlated by assigning a rank of 1 to the subject having the fewest reversals and a rank of 52 to the subject having the most, and assigning a rank of 1 to the subject taking the longest total time to find the embedded figures and a rank of 52 to the subject taking the shortest. The computed coefficient $\tau = 0.35$ ($P < .01$). We conclude, therefore, that the two sets of scores are significantly related.

Sex Differences

The men as a group reversed the figures of reversible perspective significantly more rapidly than the women, and took a significantly shorter total time to find the embedded figures.

For reversible perspective the ranges, Mdns, and Qs of the distribution of scores for each sex are as follows:

	Range	*Mdn*	*Q*
Men	10–181	41.0	12.08
Women	10–72	31.6	10.24

The significance of this difference was tested by assigning a rank of 1 to the subject having the fewest reversals and a rank of 52 to the

subject having the most and assigning a rank of 1 to the women and a rank of 2 to the men and correlating. The computed coefficient $\tau = 0.23$ ($P = .05$).

For embedded figures the ranges, Mdns, and Qs of the distribution of scores for each sex are as follows:

	Range	*Mdn*	*Q*
Men	41.5–982.5	136.5	112.8
Women	94.5–1234.0	342.6	145.4

The significance of this difference was tested by assigning a rank of 1 to the subject who took the longest total time and a rank of 52 to the subject who took the shortest, and assigning a rank of 1 to the women and a rank of 2 to the men and correlating. The computed coefficient $\tau = 0.32$ ($P < .01$). This result is consistent with that obtained by Witkin (**6**).

Summary and Conclusions

An analysis of the processes involved in (*a*) reversing figures of reversible perspective, and (*b*) finding simple geometric forms embedded in complex ones, suggested an underlying similarity. It was hypothesized that individuals who are able to reverse figures of reversible perspective rapidly would require less time to find a simple figure in a complex one, and vice versa. This hypothesis was tested for 26 male and 26 female subjects with three figures of reversible perspective and twelve pairs of simple–complex geometric figures. The results obtained are taken as substantiating evidence for the hypothesis. Significant sex differences were also observed. These are consistent with the hypothesis in that women both reversed the figures of reversible perspective more slowly than men and took longer to find the embedded figures.

REFERENCES

1. Ellis, W. D. (Ed.). *A source book of gestalt psychology*, pp. 109–122. New York: Harcourt, Bruce, 1938.
2. Hebb, D. O. *The organization of behavior*, New York: Wiley, 1949.
3. Kendall, M. G. *Rank correlation methods*, London: Charles Griffin & Co. Ltd., 1948.
4. Newbigging, P. L. The relationship between rate of reversal of figures of reversible perspective and empathy. *Canad. J. Psychol.*, 1953, **7**, 172–176.
5. Voth, A. Individual differences in the autokinetic phenomena. *J. exp. Psychol.*, 1941, **29**, 306–322.
6. Witkin, H. A. Individual differences in the ease of perception of embedded figures. *J. Personality*, 1950–51, **19**, 1–15.

NON-VISUAL PERCEPTION OF THE POSTURAL VERTICAL: III. DIAGONAL PLANES[1]

W. C. CLEGG

Defence Research Medical Laboratories, Toronto, Ont.

Two earlier papers (**1, 2**) reported the effects of four variables upon the non-visual perception of the postural vertical following body tilt in the sagittal and lateral planes. This report deals with the effects of the same four variables following body tilt in two diagonal planes situated midway between the planes previously studied. These are referred to as the left and right diagonal planes (see Figure 1).

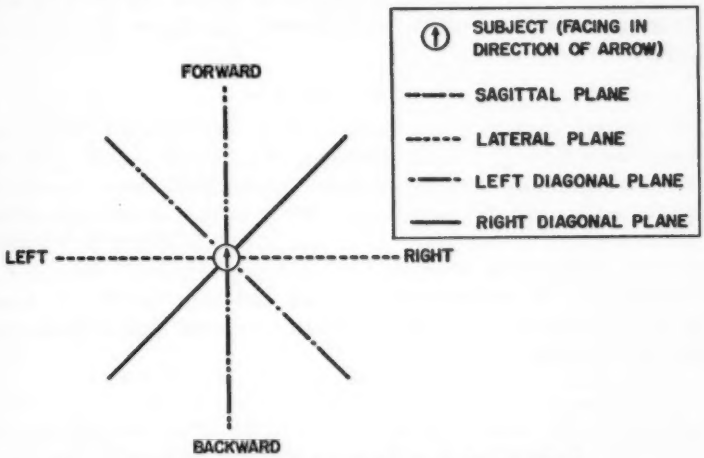

FIGURE 1. Relative positions of various planes studied.

The variables studied were: (*a*) the degree of initial tilt, i.e., the degree to which the subject was tilted before being moved toward the vertical, (*b*) the time held at initial tilt, (*c*) the direction of initial tilt, and (*d*) the angular velocity of return.

The earlier reports (**1, 2**) have referred to investigations particularly pertinent in this area. There is general agreement that the non-visual perception of the postural upright, when moving toward the vertical

[1]Defence Research Medical Laboratories Project No. 75–134–33, Report No. 75–3, P.C.C. No. D77–94–35–36, H.R. No. 79.

from positions in the lateral or in the sagittal plane, is influenced by the magnitude of initial tilt (errors increase as magnitude increases); the speed of return (errors increase as speed decreases); and the direction of initial tilt. In the lateral plane errors are greater when initial tilt is to the right; in the sagittal when it is backward. Subjects differ significantly in their ability to estimate the vertical. On the question of the time held at initial tilt, the literature reveals some disagreement as to the effect upon the magnitude and direction of error.

Apparatus

The apparatus has been described in detail elsewhere (**1**). It consisted of a chair in which blindfolded subjects with their heads fixed, could be tilted to various positions along the right or left diagonal planes and returned toward the gravitational vertical at various velocities. A large protractor, readable to within ⅛°, indicated the degree of tilt of the apparatus.

General Procedure

The general procedure was identical with that reported earlier (1). Subjects were tilted to various positions (9°, 12°, 15°) away from the vertical along the right or left diagonal planes, held there for varying intervals of time (15, 30, 45 seconds), and returned toward the vertical at various speeds (6.5°, 14.0°, 17.5° per minute). When they judged they were upright they responded by sounding a buzzer. The order of presentation of the variables was random and each subject was tested once for each combination of the variables. Five adult male subjects were tested in each plane.

Results

An analysis of variance of the results obtained in the left diagonal plane (Table I) revealed that there are highly significant differences in degree of mean error attributable to subjects, speed of return, degree of initial tilt, and direction of tilt. No significant differences between delay times were revealed.

Table II shows the mean errors obtained for the same plane with the different values of the experimental variables. It can be seen that greater mean errors occur when subjects move from right-backward tilt than from left-forward tilt; that the mean errors tend to decrease as speed of return increases; that mean errors increase as degree of tilt increases; and that for the various delay times there is no appreciable difference in mean errors.

The observations concerning the influence of magnitude of initial tilt on mean errors are in general agreement with previous studies (**1, 2, 3, 4**).

TABLE I

ANALYSIS OF VARIANCE TABLE—LEFT DIAGONAL PLANE
2×3×3×3 FACTORIAL WITH 5 REPLICATIONS (SUBJECTS)

Source	d.f.	Sums of squares	Mean squares	F-ratio
Subjects (R)	4	948.91	237.23	24.99**
Direction (Q)	1	248.45	248.45	26.21**
Delay time (T)	2	11.00	5.50	0.58
Speed of return (S)	2	114.99	57.50	6.07**
Degree of tilt (D)	2	221.50	110.75	11.68**
Q×T	2	2.82	1.41	0.15
Q×S	2	4.85	2.42	0.26
Q×D	2	14.85	7.43	0.78
T×S	4	38.95	9.74	1.03
T×D	4	11.46	2.87	0.30
S×D	4	8.42	2.10	0.22
Q×T×S	4			
Q×T×D	4			
Q×S×D	4			
T×S×D	8			
Q×T×S×D	8			
Error	212	2010.18	9.48	
Total	269	3636.38		

**Significant at the 1% level.

TABLE II

MEAN ERRORS FOR EACH VARIABLE—LEFT-DIAGONAL PLANE

Variable		$\bar{X}$
Direction	Left-forward	−0.70
	Right-backward	−2.62
Return speed	6.5°/min.	−2.37
	15.0°/min.	−1.81
	17.5°/min.	−0.79
Degree of tilt	9°	−0.41
	12°	−2.04
	15°	−2.53
Delay time	15 sec.	−1.39
	30 sec.	−1.70
	45 sec.	−1.88

The observations concerning "delay time" agree with the findings of the earlier studies in this series (1, 2) but disagree with those of others (4). Velocity of return influenced mean error as it did in previous experiments (1, 2). The significant difference between the mean errors of the two directions is supported by previous work (1, 2, 3).

Table III shows the results of an analysis of variance of the data obtained in the right diagonal plane. This analysis reveals highly significant differences in degree of error attributable to subjects, speed of return, and degree of tilt among the main effects in the experiment. Direction of tilt and delay time did not influence error significantly.

All the first order interactions and all but one of the second order interactions are revealed to be highly significant.

The findings concerning return speed, degree of tilt, and delay time agree with those found for left diagonal tilt and with those reported earlier (1, 2).

Discussion

The effect of direction of tilt upon error revealed in these experiments is as would have been predicted from the two previous reports (1, 2). Since return from backward and from right tilt resulted in significantly

TABLE III

Analysis of Variance Table—Right Diagonal Plane
2×3×3×3 Factorial with 5 Replications (Subjects)

Source	d.f.	Sums of squares	Mean squares	F-ratio
Subjects (R)	4	240.64	60.16	29.34**
Direction (Q)	1	0.26	0.26	0.12
Delay time (T)	2	3.75	1.88	0.92
Speed of return (S)	2	379.90	189.95	92.66**
Degree of tilt (D)	2	203.22	101.61	49.57**
Q×T	2	243.83	121.92	59.41**
Q×S	2	234.63	117.32	57.23**
Q×D	2	230.91	115.46	56.32**
T×S	4	233.98	58.50	28.54**
T×D	4	253.19	63.30	30.88**
S×D	4	231.56	57.89	28.24**
Q×T×S	4	73.50	18.38	8.97**
Q×T×D	4	56.27	14.07	6.86**
Q×S×D	4	18.02	4.50	2.20
T×S×D	8	64.26	8.03	3.92**
Q×T×S×D	8	450.83	2.05	
Error	212			
Total	269	2918.75		

**Significant at the 1% level.

greater errors than from the opposite directions, it was anticipated that return from the right-backward direction would show significantly greater errors than from left-forward. This is shown in the first experiment.

The left-backward and right-forward positions are between those positions showing greater error (backward and right) and those positions showing less. For this reason a lesser degree of difference in error between these two directions was expected. The data from the right diagonal plane revealed no significant difference in error attributable to these directions. The significant first and second order interactions found in these data (Table III) suggest that subjects were unable to resolve the difficulties presented by conflicting cues of right-forward and left-backward and hence made large errors but showed no preference for either direction.

Summary and Conclusions

Experiments in a tilting chair apparatus investigated the effects of degree of tilt, direction of tilt, duration of tilt, and speed of return from tilted positions in the right and left diagonal planes in the absence of visual cues. From these experiments it may be concluded that:

1. The non-visual perception of the postural upright in subjects moving toward the vertical from positions of tilt in the right or left diagonal planes is influenced by the magnitude of tilt and the speed of return. Errors in perception of the vertical increase as the magnitude of initial tilt increases, and as the velocity of return decreases.
2. In the left diagonal plane subjects returning from positions of right-backward tilt make significantly larger errors than from left-forward tilt.
3. Direction of tilt in the right diagonal plane does not affect errors of perception of the vertical.
4. The duration of tilt preceding return to vertical has no significant effect on the magnitude and direction of error.
5. Subjects differ in their ability to estimate the vertical.
6. These results agree with those reported for tilt in the sagittal and lateral planes (**1, 2**).

REFERENCES

1. Clegg, W. C., & Dunfield, N. M. Non-visual perception of the postural vertical: I. Sagittal plane. *Canad. J. Psychol.*, 1954, **8**, 1–9.
2. Clegg, W. C., & Dunfield, N. M. Non-visual perception of the postural vertical: II. Lateral plane. *Canad. J. Psychol.*, 1954, **8**, 80–86.
3. Fleishman, E. A. The perception of body position. Effects of speed, magnitude, and direction of displacement on accuracy of adjustment to an upright position. *Human Resources Research Center Bulletin*, 1953, 53–1. San Antonio, Texas: Lackland Air Force Base.
4. Symposium. *Psychophysiological factors in spatial orientation*. Pensacola, Florida, October 1950, NAVEXOS P–966.

TESTING LOGICAL KEYS IN MEASURES OF ATTITUDE

MAURICE F. FREEHILL AND ALEXANDER MILTON
Bureau of Research, Western Washington College of Education

PSYCHOLOGICAL measurement continues to be hazardous business. Complex and variable human responses combine with ethical limitations on experimentation to confound and humble the psychologist before his colleagues in the natural sciences. Perhaps in competition, or perhaps in despair, he is sometimes tempted to make, to defend, to endorse, and to use measuring devices characterized by hasty conception, careless preparation, and limited validation.

Attitude measurement, particularly, has been productive of research projects and conclusions that are largely supported by meandering rationalization. In this area there is extensive need for the consistent combination of logic with statistical evidences.

These issues are of major concern to a subcommittee in the current *Cooperative Study of Evaluation in General Education* (1). This subcommittee on attitudes and adjustment has attempted to measure a "democratic" attitude—one of respect for the worth and dignity of others. One of the experimental instruments appears as a plausible achievement test and has been entitled *Problems in Human Relations Test.* It is based on the assumption of bias in performance. Solutions to hypothetical social problems are selected from multiple choice responses.[1] Each of the possible responses or foils is designed to elicit bias in what appears as subject matter achievement material. The test name and content is chosen to provide cover for the true purpose. It is assumed that attitude will operate in the selection of foils and that consistency of choice will result from bias. Therefore, each of the possible responses or foils bears a disguised relation to democratic attitude. Certain selections are expected to indicate democratic bias, whereas others indicate biases toward autocracy, dependence on experts, or laissez-faire procedures.

Basically the key was intended to measure the democratic attitude,

[1]Item number 23 from the *Problems in Human Relations Test*: "In talking with a laborer about a projected strike at his plant, you think he is overlooking the facts favorable to the employer's stand. What would you do?

1. Nothing, because you couldn't influence him anyhow.
2. Ask what he thinks of this additional information.
3. Get him to talk to a labor relations expert.
4. Contend that there is always something to be said for the other side.
5. Show him that striking is a poor method of settling disputes."

but it also attempts minimum diagnosis of the absence or limitation of that attitude. Hence there are scores on sub-dimensions of "hard-boiled autocrat," "laissez-faire," and "resort to expert." These sub-dimensions were designed to define or describe the attitude of subjects who had low scores on the "democratic" scale.

The committee, aware of the tentative nature of the theory, has been conscious of the desirability for exhaustive examination of reliability and validity in the instrument. They have, furthermore, been sensitive to the danger of scoring keys that are logically derived. The experts who construct such scales have attitudes and consequent biases. Therefore the committee has constantly sought evidence that should halt or advance their construction of items, tests, and keys.

Logical keys for the five scales were constructed by the committee, but there was need for a more adequate demonstration that each of the scores might serve as a description for a unitary variable. Failure to find this consistency would not disprove the separate existence of the characteristic outside the test, but would invalidate the score. Consistency, on the contrary, would support the assumption that the test elicits a body of response that may be symptomatic of a particular attitudinal bias. There was, furthermore, the hope that tests of these keys would indicate additional items in the major category or in minor dimensions and thereby increase reliability.

The method which was derived for the construction of the democratic attitude scale keys should have applicability in the field of personality and attitude measurements. The procedure combines the logical and statistical selection of items in a short-cut process which utilizes the efficiency of the IBM test scoring machine and the simplicity of the Kuder-Richardson reliability procedure.

Method

The process used is simple and mechanical. These characteristics are necessary in a technique that is to be used in a cooperative study where the computation is done in several places and by different persons, few of whom are highly skilled statisticians.

Essentially, the technique is as follows: (*a*) A brief logical key is established using only the foils on which there is expert agreement. This initial key of four to eight items serves as a first scoring key for the dimension or sub-scale being studied. (*b*) Answer sheets are scored on this first key and a Kuder-Richardson reliability coefficient is computed. (*c*) Item responses are tabulated on the graphic item counter of the IBM test scoring machine and item comparisons are made for the upper and lower groups (27 per cent) as separated on the basis of scores on

the initial key. Significance of these items is readily estimated from any of the tables designed for this purpose, such as Flanagan's tables for the biserial correlation (2) or Jurgensen's tables for the ϕ coefficient (3). (*d*) The most significant discriminators are added to the original key. These may include both foils that are significantly chosen and foils that are significantly rejected. Thus a new and enlarged key is developed. (*e*) The answer sheets are now scored on the new key and a new Kuder-Richardson reliability is computed.

The process is continued as long as it is productive. In construction of the democratic attitude scale, six to ten keys were ordinarily necessary to exhaust the value of possible extension. A general rule for determining the limits of extension of the scale is: Continue until there is no significant increase in reliability, or there are no new foils at acceptable levels, or there is such shifting of foils that the original keys are altered or lost to a degree which destroys the meaning of the categorization.

Horst has suggested a method of "successive residuals" which is in some respects similar (4). His procedure, however, involves the addition of successive items which correlate highly with an external criterion rather than with an internal core.

Application to the "Laissez-Faire" Sub-scale

The applicability of this process may readily be seen in the construction of the democratic attitude sub-scales. The logical key for the theoretical "laissez-faire" category was one of the keys which proved to be internally consistent and was extended and strengthened by the method outlined above.

A brief logical key was established, consisting of the four most discriminating items upon which there was expert agreement. This first key was used to score 125 answer sheets from five colleges in groups of 25 from each college, selected to represent the characteristic range of "democratic" scores in that college. A Kuder-Richardson reliability coefficient was computed on this base key. Item comparisons were made for all the test items between the upper and lower 27 per cent of the papers, divided on the basis of the first scoring. Discriminating items were added to the base making a new key consisting of eight items. This process was repeated ten times, with significant items being added and non-significant items being dropped. A step-by-step review of this process is presented in Table I.

The final laissez-faire key consisted of 38 foils to be accepted and 23 foils to be rejected. The key achieved a reliability of .842. It will be noted that only one item was dropped as a result of the process. The sharp increase in reliability between step 7 and step 8 is due to the addition of

TABLE I

SUCCESSIVE STEPS IN THE DEVELOPMENT OF THE "LAISSEZ-FAIRE" SUB-DIMENSION. NUMBER OF ITEMS ADDED IN EACH STEP AND THE RESULTING RELIABILITIES

Step	Items added to key		Items dropped from key		Kuder-Richardson reliability
	Chosen	Rejected	Chosen	Rejected	
Original	4	—	—	—	.144
2	+4	—	—	—	.340
3	+8	—	—	—	.551
4	+6	—	—	—	.608
5	+6	—	—	—	.667
6	+5	—	—	—	.679
7	+5	—	—	—	.684
8	—	+11	−1	—	.796
9	—	+7	—	—	.830
10	+1	+5	—	—	.842

11 foil rejections which had not been added previously because this computation preceded the final determination of method. No significant increase in reliability was obtained after the tenth addition.

Application to the "Benevolent Autocrat" Sub-scale

Another theoretical category on the test was entitled "Benevolent Autocrat." Previous data indicated that this category was not well defined within the test. These scores had minimal relationship with several divergent characteristics of attitude and very limited relationship with estimates by instructors.

An early estimate of the reliability, based on a small sample, was −.13. Later processing indicated that no consistent "Benevolent Autocrat" scale was demonstrated. Results of this treatment are presented in Table II.

When processed, the initial reliability was .17 for the seven-item logical base key. After the sixth step the scale consisted of 26 foils to be accepted and 25 foils to be rejected. The reliability had risen to .75. However, this sixth key contained only half the items from the initial two keys, and of these, two had shifted from positive contribution to negative contribution in the sub-dimension score. This was taken as evidence of continuous shift in psychological meaning of the key, and the key was abandoned.

The three other dimensions of the test were processed similarly. The "democratic" scale rose from a reliability of .38 on the initial key to a

TABLE II

SUCCESSIVE STEPS IN THE DEVELOPMENT OF THE "BENEVOLENT AUTOCRAT" SUB-DIMENSION. THE SHIFT OF MEANING IS NOTED IN THE HIGH NUMBER OF DROPPED ITEMS

Step	Items added to key		Items dropped from key		Kuder-Richardson reliability
	Chosen	Rejected	Chosen	Rejected	
Original	7	—	—	—	.170
2	+9	+6	—	—	.373
3	+2	+7	−5	−1	.540
4	+4	+7	—	—	.630
5	+6	+5	−2	−4	.707
6	+6	+6	−1	−1	.754

reliability of .83 on the seventh key. The "resort to experts" category achieved a final reliability of .69 and the "hard-boiled autocrat" a reliability of .82. None of these keys displayed the shift in meaning found in the "benevolent autocrat" category.

This technique proved practical both in terms of adequacy in the investigation, and in terms of the simplicity required in a widespread operation. It served as a test of the logical keys and provided confirming evidence for anticipated strengths and limitations in these dimensions. Furthermore, it extended the keys and consequently increased their reliability. The process may be recommended because it is usable, direct, and simple.

REFERENCES

1. *Cooperative study of evaluation in general education.* East Lansing, Michigan: American Council on Education.
2. FLANAGAN, J. C. *A table for obtaining the biserial correlation coefficient.* Pittsburgh: American Institute for Research, 1950.
3. JURGENSEN, G. E. Table for determining phi coefficients. *Psychometrics,* 1947, **12,** 17–29.
4. HORST, PAUL. Item analysis by the methods of successive residuals. *J. exper. Educ.,* 1934, **2,** 254–263.

AN ELECTROMYOGRAPHIC STUDY OF LISTENING AND TALKING[1]

A. ARTHUR SMITH, ROBERT B. MALMO, AND CHARLES SHAGASS[2]
Allan Memorial Institute of Psychiatry and McGill University

MENTAL work has frequently been shown to be accompanied by increases in tension of the musculature. That there is a close connection is not a new idea; according to Humphrey (4, p. 187) it goes back at least as far as the Wurzburg school and the controversy about "imageless thought." Experimental evidence for the connection has been advanced by Jacobson (5), Freeman (3), and Davis (2), among others. More recently, Smith (6) has demonstrated the existence of goal-related gradients of tension during mirror-drawing. These he attributed to the action of a central "thought" process, involving factors of anticipation and attention.

The present report[3] is concerned with the appearance of similar tension gradients, under circumstances where overt activity was not in question.

METHODS

Subjects

Thirty-three Ss were tested. Of these, 22 were patients undergoing treatment in the psychiatric department of a general hospital. There were 11 male and 11 female patients; their median age was 30 years. Of these, 19 were classed as psychoneurotics, and 3 as paranoids.

Eleven college students served as a control group. Six were male, five female; the median age of the controls was 20 years.

Materials and Apparatus

A magnetic tape-recording was made of a short article on sleep. While the record was being made, the volume control of the apparatus was decreased at intervals to a point where subsequent reproduction was almost inaudible—although it could be

[1]This investigation was supported by the Medical Research and Development Board, Office of the Surgeon General, Department of the Army, U.S.A., under Contract No. DA–49–007–MD–70.

[2]The authors wish to acknowledge the assistance of Miss Evelyn Braginetz, Mr. A. K. Bartoshuk, Mr. R. E. Quilter, and Mr. W. B. Richards. The work was aided by the cooperation of the Department of Veterans' Affairs, Canada.

[3]Initially, this study was planned with a view to observing the arousal of tension under conditions of difficult listening, and its discharge through talking. For various reasons this goal could not be reached. The resultant data seemed instead more closely related to changes in interest and attention.

heard if S made an effort. Total playing time of the record was 400 seconds. There were 17 periods of reduced audibility, varying in length from 2 to 10 seconds, with a mean duration of 5 seconds. On the same tape, the article was preceded by one minute of recorded instructions.

In these instructions S was told that a short article would be read to him, and that he was to listen carefully so that he would grasp the ideas of the article and be able to recall them afterward. He was warned that the recording would be poor in spots, "like a bad radio." He was asked not to move or talk, to keep his eyes closed, and to be as relaxed as possible, while paying attention to what he would hear.

Continuous bipolar EMG tracings from five different muscle groups were taken throughout the experiment. The recording apparatus was an Offner Type D 8-channel electroencephalograph. As an aid in quantifying muscle-potential data from the primary tracings, the outputs of four of the EEG amplifiers were fed into direct-reading manually triggered integrators (1, p. 51), with an integration period of ten seconds. A marker pen, coupled to the timing circuits, marked off each integration period on the primary ink record (see Figure 1).

Lead placements were forehead, neck, chin, and extensors of right and left forearms (for details see 1, pp. 16–24, pp. 30–32). S also wore a single-crystal throat microphone, whose output was amplified and recorded on one channel of the EMG (see Figure 1). To provide a standard relaxed posture, S lay on an adjustable hospital bed.

Procedure

1. *Preliminary instructions and electrode placement.* On arrival S was told that the test would involve "thinking and remembering." After brief assurance as to the function of the apparatus, the electrodes were attached. S was then taken to the test room and asked to lie on the bed. He was warned that he would have to remain in the same position throughout the test. The bed was adjusted to his liking, and earphones were placed.

2. *Before listening.* S was asked to lie quietly for a few minutes; electromyographic recording then began. This quiet period lasted 3½ minutes; at its close S was warned "You will hear the record now."

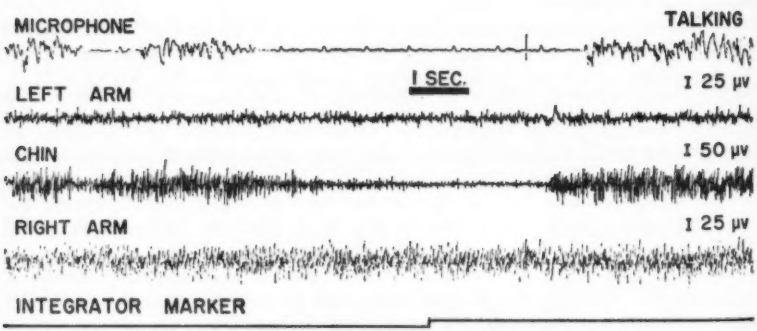

FIGURE 1. Electromyograms during speech.

3. *Listening.* *E* started the playback, and *S* heard the recorded instructions and the article. At the end, *S* was again asked to remain quiet.

4. *Recall of content.* After three minutes of silence, *E* said, "Tell me what you remember of the record." *E* wrote down what *S* recalled.

5. *Questions about feelings.* Three minutes later *E* asked, "How do you feel about that record?" This question was intended to bring out some expression of feeling on the part of *S* about the quality of the record. If, as was often the case, *S* did not understand the question, or did not comment on his feelings, the query was amplified by the use of one or more of the following questions: (*a*) "What were your feelings while listening to the record?" (*b*) "Was it a good record?" (*c*) "Did that (the fact that you could not hear) bother or annoy you in any way?"

No further questions were used; and questioning proceeded only until *S* made some statement either admitting or denying response to the difficulty of hearing.

A final three-minute silent period followed.

After all electrodes had been removed, *S* was given a brief standardized interview designed to bring out any points not covered before.

Treatment of Data

In the present analysis the main source of data was the integrator readings. Each integrator reading was proportional to the average muscle potential amplitude during a ten-second period; three readings were taken for each minute of the test. Each reading was later converted into microvolts by comparison with a standard calibration signal.

Four channels were integrated; these were forehead, neck, right extensor, and left extensor. Comparable values for the fifth channel (chin) were determined by the use of special scales. The data were then combined in successive groups of three, to give measures of the average tension for each minute of the test. All statistical operations were carried out either on these one-minute averages, or on combinations of these (such as the mean tension during the listening period).

Measures of verbal activity were derived from the throat microphone recording. Bursts signifying speech could be separated clearly from the intervening silent intervals (see Figure 1). These periods of speech were marked off, measured, and summed for the two periods when *S* spoke (during recall and while answering questions about feelings). The same was done for the silent intervals. A measure of the relative amount of verbal activity ("per cent time talking") was computed from the ratio T/T+S, where T represents the sum of the intervals of talking, and S the sum of the silent intervals.

Curves of recall were obtained from *E*'s protocols. The article on sleep was divided into quarters by word count. From the protocol, each idea or fact reported by *S* was assigned to one quarter of the article, without regard to the order in which it had been recalled. For example, the number of facts reported by *S* which had appeared initially in the first quarter of the article was his recall score for that quarter.

Results

A comparison of the muscle tension before and after listening to the recorded article revealed no significant change, towards either higher or lower tension. It therefore proved impossible to assess the effectiveness of talking as a tension reducing mechanism.

TABLE I

EFFECT OF LISTENING ON MUSCULAR TENSION

(microvolts)

	Forehead	Neck	Right arm	Left arm	Chin
Silence	13.59	7.02	9.10	7.73	13.08
Listening	13.83	6.85	12.08	10.75	15.41
Increase	0.24	−0.17	2.98	3.02	2.33
Significance level	—	—	1%	1%	5%

Tension During Listening

The average change in muscle tension which occurred while the Ss were listening to the record is shown in Table I. The chin muscles and the extensor muscles of both arms increased significantly in tension; forehead and neck muscles were unaffected.

More interesting than these overall changes are the minute-by-minute shifts in tension. These are plotted in Figure 2, for chin, right arm, and left arm. The three-minute period of silence after listening is also shown.

In the arms, tension rose quite rapidly, reaching a peak in the seventh minute (second minute of listening); then it declined steadily to regain the pre-level by the end of the post-record rest period. In the chin muscles, except for a momentary increase during instructions, tension rose more gradually. Maximum tension here was not reached until the ninth minute.

The significance of this difference was computed by subtracting (for each S) the time at which peak arm tension occurred from the time of peak chin tension; the obtained mean difference of two minutes is significant at the 1 per cent level of confidence.

Recall

Comparing recall scores for the first and last quarters of the article, controls and patients remembered more items from the first quarter; this difference is significant at the 1 per cent level. Comparisons among other sections of the article were not made. It seemed clear that only the first and last quarters were reasonably comparable in content and in the way in which the ideas were presented.

Comments of S's

Less than half of the Ss found the article at all interesting. Of the others, seven had trouble keeping awake. This is not altogether surprising, as each S had been told to relax and keep his eyes closed. The controls

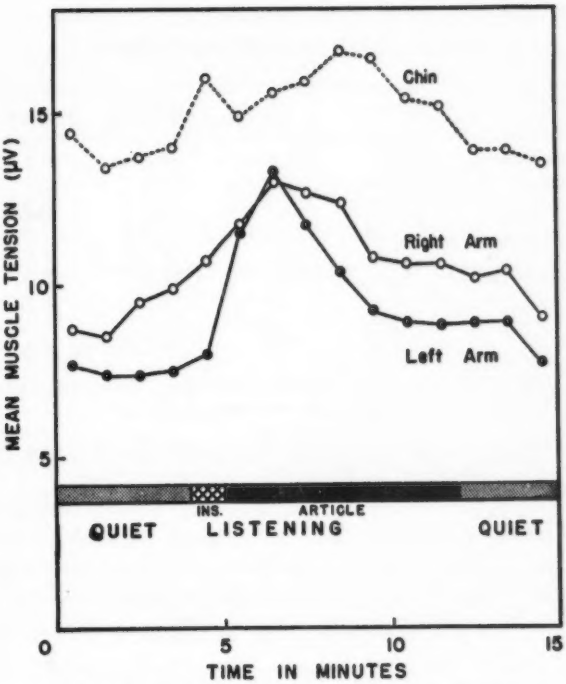

FIGURE 2. Muscle tension gradients during listening.

were as prone to sleepiness as the patients. Others reported a wandering of attention.

Very few of the Ss said that they had felt disturbed by the fading of the record. This was the case when they were asked (during questions about feelings) "Did that annoy you?" and when the question was brought up later, in the interview.

Tension During Talking

Table II shows the overall effect of the two periods of speech on muscle tension. As well as the expected prominent rise in the chin (speech) muscles, talking was accompanied by a definite increase in the other muscle groups. These increases are all significant at the 5 per cent level or better.

Durations of talking varied from S to S. In order to obtain mean values of tension we employed the Vincent method, computing average tension

TABLE II

EFFECT OF SPEECH ON MUSCULAR TENSION
(microvolts)

	Forehead	Neck	Right arm	Left arm	Chin
Silence	13.2	6.6	10.3	9.3	14.4
Recall of content	16.4	8.7	16.4	13.0	82.7
Increase*	3.2	2.1	6.1	3.7	68.3
(prob.)	(.05)	(.001)	(.001)	(.05)	(—)
Silence	13.4	7.5	10.5	9.0	20.3
Questions about feelings	15.5	8.7	13.5	13.5	67.2
Increase*	2.1	1.2	3.0	4.5	46.9
(prob.)	(.05)	(.05)	(.01)	(.05)	(—)
Silence	12.9	7.8	10.5	8.1	18.6

*Chance probabilities of obtained differences are given in brackets; differences for chin not evaluated statistically because of their magnitude.

during successive thirds of the speech periods. The Vincent curves for chin tension are exhibited in Figure 3.

Also shown is the relative amount of speech activity during the same periods. The curves indicate little relationship between percentage of time talking and chin tension. Data from correlations also support this. Product-moment *rs* which were computed for these variables (and for each third of both talking periods) ranged from +.20 to —.10; none was significant.

Comparisons of Patients and Controls[4]

When due allowance was made for age, patients were found to differ from controls only in chin tension. The first such difference occurred during listening; patients showed a slightly higher tension level. This difference was small, amounting to not more than 1.5 microvolts, but was significant at the 5 per cent level of confidence.

During questions about feelings (see Figure 3), the control group rose in average tension from the first to the second third of the period; their tension then dropped rapidly to a value well below that recorded during any other interval of speech. The patients, on the other hand, although they showed a similar rise from first to middle third, then maintained this tension level practically unchanged through the rest of the period. The difference (between maintained tension in the patients and falling tension in the controls) was significant at the 0.1 per cent level of confidence.

[4]All comparisons in this section are based upon analysis of co-variance, with age as the matching variable. The correlation of age with muscle tension in this study was .35.

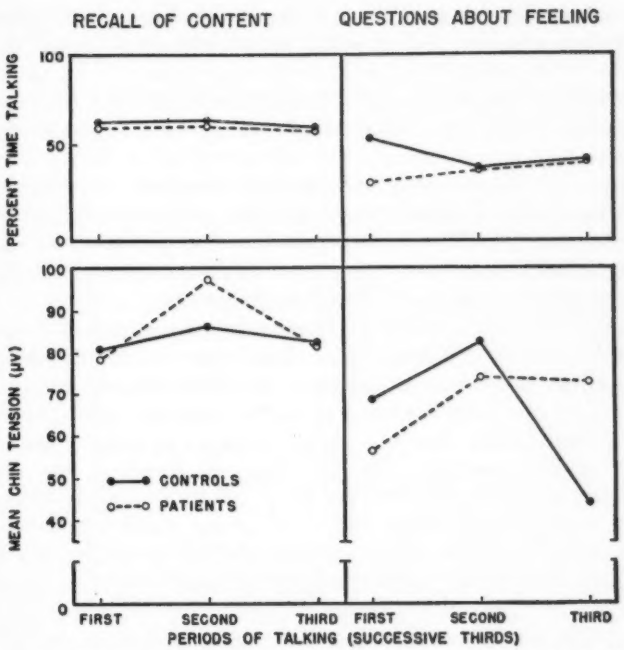

FIGURE 3. Chin tension and overt speech activity during two periods of talking.

DISCUSSION

The present investigation was designed initially to study the arousal and discharge of tension through the use of verbal materials. It seems clear that this object was not attained. No lasting increase in muscular tension was achieved; nor did the Ss, judging by their reports, find the article to which they listened particularly "arousing"; indeed, for many of them it proved soporific.

Tension and attention. If, then, concepts of arousal and discharge appear inadequate, what alternative explanation is available for the tension gradients which did occur while S was listening? We have observed a significant difference in the timing of the response in the chin and in the two forearm extensors; this suggests that two processes are involved. We shall consider first the relatively slow rise and fall of tension in the chin.

This change occurred specifically in muscles concerned with speech, and under conditions where attention to verbal material was a main requirement. The level of tension waxed and waned; so, apparently, did

the Ss' interest. That at least seems the most plausible deduction from the retrospective accounts, and from the objectively poorer recall of ideas from the latter part of the article.

As a tentative hypothesis, then, we suggest that tension in the speech muscles here reflects the degree of interest in and attention to the task at hand.

Such an explanation would resemble that advanced in the case of the previously mentioned gradients of tension in the active arm during mirror-drawing (**6**). There tension was found to increase as a function of perceived distance from the goal, and the gradients were interpreted as reflecting the action of a central thought process.

One point must be emphasized. Present data do no more than suggest such an hypothesis. Confirmation or denial must await the outcome of further experiments, now in progress, in which the effect on muscle tension of undistracted listening to verbal material (such as a short detective story which rises to a definite climax) is being investigated.[5]

What of the seemingly different course of events in the extensor muscles of the forearms? Freeman (**3**, p. 231) has suggested that distraction during mental work will produce an initial rise in tension, followed by a decrease as the S becomes adapted to the situation. While "distraction" may not be the best term in this case, something analogous may have happened. Fading rendered parts of the article hard to hear, implying thereby that extra effort was required. Tension in the arm muscles may be a measure of this extra effort: initially great, then decreasing as S became accustomed to the difficulty.

Speech muscle tension during speech. Possibly the most interesting finding here is that shown in Figure 3: the lack of relationship between measures of overt speech activity, and the level of tension in the muscles concerned. In general the facts are that, whereas talking elevates the tension level above that recorded during long intervals of silence, fluctuations in activity during periods of speech are not necessarily accompanied by parallel tension changes. This implies that tension in the speech muscles is not uniquely determined by the peripheral activity of the moment: there would appear to be something more, perhaps some central factor of interest, or attention, or expectation of the next word or phrase.

The meaning of the difference in tension between patients and controls (see Figure 3) is still obscure. The main finding was that, at the end of a period of questioning about their feelings, chin tension in the patients remained high, while controls showed relaxation. Analysis of

[5]One such study, by Harvey Wallerstein, appears in the present issue [Ed.].

the measures of percentage of time talking shows that this was not because the patients talked more. There are at least three possible explanations: (*a*) Patients were more disturbed by distraction (fading) than controls. Since this period dealt with direct questions about the annoyance from the fading, the greater disturbance of the patients may have shown itself in higher tension. But opposed to this is the fact that patients, like controls, denied feelings of annoyance. (*b*) Questions about feelings and emotions may in general be more stressful to patients than controls. Although this is possible, we are now aware that tensional rise need not mean emotional disturbance. (*c*) The third explanation is more in line with an hypothesis of "attention": that the maintained tension in the patients is related to their greater interest in questions about their feelings. It is not unreasonable to suppose that patients undergoing psychotherapy might be more interested in such questions than the control subjects.

Summary

Twenty-two psychiatric patients and 11 normal controls listened to a faulty sound recording. They were later asked to tell what they remembered of the record, and to report on their feelings while listening. EMGs from five muscle groups were recorded continuously throughout the experiment. Results were:

1. During listening, rising and falling gradients of tension were observed in speech muscles, and in extensor muscles of both arms.

2. All muscles recorded from showed significant increases in tension with talking.

3. Differences between patients and controls were seen only in speech muscles, and then chiefly during questioning about feelings.

The EMG gradients obtained in the present study were considered in relation to other such gradients observed in various kinds of performance on mental and motor tasks. The hypothesis was suggested that EMG gradients of this kind are related to phenomena of attention.

REFERENCES

1. Davis, J. F. *Manual of surface electromyography.* Montreal: Laboratory for Psychological Studies, Allan Memorial Institute, 1952 (mimeo).
2. Davis, R. C. The relation of certain muscle action potentials to "mental work." *Indiana Univ. Pub. Sci. Ser.*, 1937, No. 5, 1–29.
3. Freeman, G. L. *The energetics of human behavior.* New York: Cornell University, 1948.
4. Humphrey, G. *Thinking.* New York: Wiley, 1951.
5. Jacobson, E. *Progressive relaxation.* Chicago: Univer. of Chicago Press, 1938.
6. Smith, A. A. An electromyographic study of tension in interrupted and completed tasks. *J. exper. Psychol.*, 1953, **46**, 32–36.

AN ELECTROMYOGRAPHIC STUDY OF ATTENTIVE LISTENING[1]

HARVEY WALLERSTEIN[2]
Allan Memorial Institute of Psychiatry and McGill University

COURTS (3) has reviewed some studies of muscle tension changes during mental arithmetic and memorization tasks. An increase of tension from rest to mental activity was reported by most investigators. The increases seemed to involve multiple factors such as degree of difficulty, distraction, and practice.

Recently, experiments have been concerned less with tension changes from rest to activity than with changes during the course of a given task. Smith (7) reported a continuous increase of tension in the active arm during mirror drawing. He interpreted this rising gradient as associated with increasing organization of central neural events underlying progress through the task; active arm potentials being a motor index of these central events. This gradient was confirmed in a similar experiment by Bartoshuk (1), who found in addition very regular increases in the passive arm, as well as rising (though less regular) gradients in the chin (2).

The question whether these rising gradients of muscle tension would occur during tasks requiring no overt movements, e.g., during listening activity, has not been fully answered. Thus far, there has been one pertinent study, which has proved both equivocal and provocative. Smith, Malmo, and Shagass (8) requested subjects to listen to a six-minute recorded article, with instructions to remember. Since the purpose was to induce stress, the playback was made difficult to hear in spots, by lowering the volume over a number of short, random intervals.

Under these conditions, recordings from the chin and forehead muscles reached peak amplitude at the fourth minute and then declined. Left

[1]This research was performed under Contract No. DA–49–007–MD–70 between the U.S. Department of the Army, Office of the Surgeon General, and McGill University. The present report is based on a thesis submitted to McGill University, in partial fulfilment of the requirements for the degree of Doctor of Philosophy. Grateful acknowledgment is made of the interest and support of Dr. Robert B. Malmo in the execution of this research, and to Dr. Tom J. Boag for assistance during its preliminary stages.

[2]Now at the Department of Psychology, Maudsley Hospital, University of London, England.

and right forearm muscle potentials rose and declined more quickly and sharply. Comments of the subjects suggested a lack of sustained interest in the presentation, rather than concern over its poor quality. The authors suggested that the rise and fall of the curves for the facial muscles may have been associated with the presence and decline of attentive listening. This interpretation, although reasonable, was possibly complicated by other factors such as disturbance and difficulty.

Would continuous attentive listening, with such factors minimized, produce rising gradients of muscle tension? The present experiment was designed to answer this question. In addition, a study was made of (*a*) listening to materials differing in ease of comprehension; (*b*) repetition of the materials—with particular reference to their influence on muscle tension.

Method

Materials. A situation was arranged in which a subject was to listen to some recorded material. An adjustable hospital bed with foam rubber mattress was provided. Two selections were used: a detective story and a philosophical essay. The story "Coroner's Inquest"—was written in dialogue form, and was therefore recorded by two voices.[3] An excerpt from Emmanuel Kant's *Critique of Pure Reason* was recorded by the person who played the major part in the story.[4] Both selections were 10 minutes long. Each was presented three times. A magictape recorder (Utah Electronics) was used for original recording and playback. A questionnaire concerning the subject's attention and feelings was devised, to be filled out when the session ended.

Subjects. Nineteen male subjects heard the detective story. Of these, 15 were university students, three were RCAF personnel, and one was a university graduate. Sixteen male individuals listened to the essay; this group consisted of 15 university students and one RCAF man. All the RCAF recruits had some secondary school training. The group who heard the story ranged in age from 18 to 31 years, with a mean age of 21.6. Ages of the "essay" group ranged from 18 to 25 years (mean, 20.9).

Recording apparatus. Muscular tension was measured in terms of electromyographic potentials between bi-polar electrodes, continuously amplified and recorded on an Edin ink-writing electromyograph. An ink-writing integrator designed by J. F. Davis (4), averaged these potentials over half-second intervals.

Recordings were taken from forehead, chin, and both forearm extensors. All lead placements were standard (4).

Procedure. Preparation for recording and the experiment proper took place in one room of a double-room suite, the other being reserved for the recording equipment. The subject was informed of the experiment's purpose: to investigate the electrical activity of his muscles while he listened to some recorded material. After making him comfortable on an adjustable bed,[5] the experimenter (the present writer) told the

[3]Marc Connelly, "Coroner's Inquest." In the Ellery Queen edition, *To the Queen's Taste*, pp. 472–477. Boston: Little, Brown, 1946.

[4]Emmanuel Kant. Critique of Pure Reason. In C. J. Friederich (Ed.), *The Philosophy of Kant*, pp. 24–27. New York: Modern Library, 1949. Sections I and II.

[5]Five subjects reclined in a leather-cushioned armchair.

subject about the kind of material he was to hear—detective story or philosophical essay—its approximate length, and that a rest period would precede and follow its presentation. This was not a test of intelligence, memory, or the like. The subject was merely to lie quietly, relax and listen, as he would to a radio program. He would be asked to close his eyes when the test commenced, to reduce distraction and eyeblink artifacts. The experimenter would stay in the same room to run the playback machine, and to keep a record of the subject's movements; the latter should be minimal. Formal instructions to this effect would be given when the test proper began.

When the subject indicated that he understood the instructions, he was asked to close his eyes. Electromyographic (EMG) recording then commenced. Formal instructions were played on the tape. A one-minute rest interval preceded the story or essay; and two minutes of rest followed it. This procedure was run through three times with intermissions of approximately five minutes.

After the third repetition, the leads were removed and the subject was seated at a table. He then formally rated his own attention and feelings during the three presentations on a questionnaire. Finally, he was asked to write a brief summary of what he had heard. The experimenter did not press the subject to recall as much as possible; he was just to put down what easily came to mind.

Treatment of data. The primary (EMG) record was used only to gain general impressions and to determine artifacts. All quantitative measurements were made on the integrator records. A 20-second sample (in mm.) was taken from the middle of each successive minute, and these measures converted to microvolts by reference to standard calibration curves. Thus from each subject were obtained, for each of the three presentations and for every channel: one microvolt value for the pre-rest, 10 values for the 10-minute presentation, and two values for the post-rest period.

Results

Frontalis. For both types of material and for all three hearings, tension rose significantly from first to last minute of listening.[6] The increases were consistent and regular from minute to minute (Figures 1 and 2). The curves show an increase from pre-rest to initial minute of listening, small but significant in every case ($P = .05$). When the story was heard, a significant drop from last minute of listening to first minute of post-rest occurred after all three presentations (Figure 1). Such was not the case for the essay; indeed, the curves after the second and third essay hearings show practically no change (Figure 2).

The increases from first to last minute of listening were of larger magnitude for the story than for the essay. Though the differences did not reach significance, those for the second hearing are suggestive ($P = .10$).

Both the essay and the story groups showed an orderly and significant fall in pre-rest tension from first to third hearings (Figures 1 and 2). It

[6]Since electrical activity as measured by electromyography parallels tension as measured by pull on a strain gauge (**6**), the present writer uses the terms *muscle potentials* and *muscle tension* interchangeably.

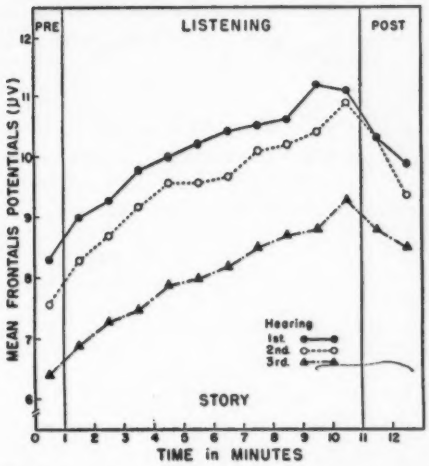

FIGURE 1. Effect of listening to a detective story on *frontalis* tension. Approximately five minutes intervened between each presentation.

is pertinent to note here that the rising gradients failed to decrease from first to third hearings; in fact, the rise from first to last minute of listening to the essay showed an orderly (though not significant) increase in successive hearings.

Two subjects fell asleep during the third presentation of the story. Their tension changes are illustrated in Figure 3. Note the fairly regular fall of tension beginning some time before the approximate onset of sleep. No other subjects showed a fall of such magnitude during listening.

Chin. A rise from first to last minute of listening to the story occurred during each presentation. This rise was close to significance for the first hearing ($P = .10$), and reached significance during the second and third hearings. Listening to the essay, on the other hand, produced only slight and insignificant changes from beginning to end, except for the third presentation, where a substantial and significant increase was obtained. When corresponding hearings of essay and story were directly compared, a significant difference was found for the second presentation: chin tension rose more when listening to the story ($P = .05$).

Curves from the chin changed less regularly from one minute to the next than those from *frontalis*. This is probably owing to the fact that the chin leads recorded from a complex of muscles which take part in speech, facial expression, and swallowing.

Pre-rest tension fell from first to third hearings for both story and essay groups. The fall for the essay group was significant. Again, as with

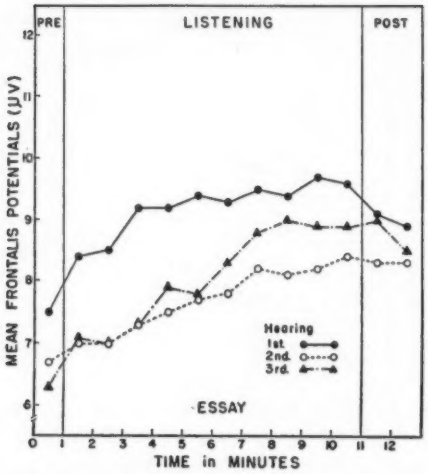

FIGURE 2. Effect of listening to a philosophical essay on *frontalis* tension. Approximately five minutes intervened between each presentation.

frontalis, the rising gradients during listening failed to decrease with successive presentations. Instead, the story gave an orderly increase from first to third presentation; the essay group, as already stated, rose significantly within the last hearing only.

Right and left extensors. Inspection of the electromyographic records gave the following overall impressions:

(*a*) Low tension (under three microvolts) present at the start and persisting to the end of the record.

(*b*) Sharp increases of muscle tension lasting anywhere from one second to a minute or more, then falling just as abruptly back to a low background.

(*c*) Appreciable individual differences in the number, magnitude, and duration of these tension bursts.

Since these bursts might have resulted from slight arm movements, as in small shifts of position on the bed, the decision was made to analyse a hearing, for any subject, only if it showed minimal burst activity.

Figure 4 shows the minute-to-minute potential changes from the right extensor. Skewed distributions demanded the use of medians rather than means as estimates of central tendency. For the same reason, significance of differences was tested by a non-parametric technique for paired replicates (**10**). Almost no significant differences of any kind appeared. An important exception was the rise from pre-rest to initial minute of the

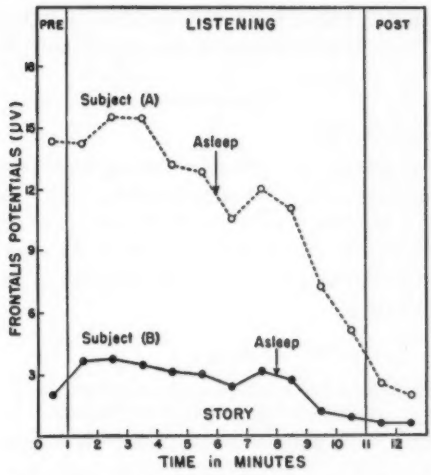

FIGURE 3. Changes of *frontalis* tension in two subjects who fell asleep, during the third hearing of a detective story.

first essay presentation. Left extensor, like right, gave essentially negative results.

In summary, the available EMG evidence presents the following picture. Rising gradients occur in *frontalis* and chin from beginning to end of listening. The magnitude of the gradients is larger when the subject is listening to the story, especially for the first two hearings. Such gradients do not appear in right and left extensors.

Retrospective data from the questionnaire. Twenty-four subjects reported being most sleepy on the third playing of the material, whereas only five were most sleepy during the second, and three during the first presentation. The probability of such an answer pattern occurring by chance is less than 1 in 1000 ($\chi^2 = 25.1$ with two degrees of freedom). Also, this decrease in alertness (or increase in sleepiness) was orderly; a majority of subjects estimating themselves less alert during the second hearing, and still less during the third hearing. Both the story and essay group followed this pattern.

The material listened to did, however, involve other dimensions of thought, such as interest, attention, anticipation. Table I indicates that, in the later hearings, such responses were more frequently reported for the essay than for the story. In other words, it required more hearings to produce maximum attention and interest in the essay than it did in the story.

Average number of words written in recall was 150 for the story and only 65 for the essay, this difference being significant ($P = .001$).

Discussion

Attention and Organization

The occurrence, during non-stressful hearing of organized material, of regularly rising gradients of tension in *frontalis*, and similar (though less regular) increases in chin, would appear to reflect a state of continued attention. An attempt to clarify this view leads to consideration of two general questions: attention under varying degrees of difficulty, and the problem of organization.

TABLE I

Subjective Comparisons of Successive Hearings along some Dimensions of Thought

(Particular hearings compared are those splitting the reports most closely into equal groups.)

	Story	Essay
Number of subjects more interested		
in 1st hearing than in 2nd	12	3
in 2nd hearing than in 1st	5	12
Story vs. Essay $\chi^2 = 8.19$; $P = .01$		
Number of subjects more attentive		
in 1st hearing than in 2nd	13	3
in 2nd hearing than in 1st	5	10
Story vs. Essay $\chi^2 = 7.30$; $P = .01$		
Number of subjects thinking ahead more		
in 2nd hearing than in 3rd	14	5
in 3rd hearing than in 2nd	5	8
Story vs. Essay $\chi^2 = 3.97$; $P = .05$		

Attention and difficulty during listening. Let us regard the present findings in the light of results previously obtained by Smith and his coworkers (in this issue of *Canad. J. Psychol.*, p. 221). On presentation of poorly recorded and rather dull material, which the subjects were instructed to remember, significant changes occurred in the muscles of right and left arms. Both extensors rose abruptly, reached their peak in two or three minutes, and then declined. Our investigation, on the other hand, showed almost no such extensor changes during listening. It seems, therefore, that in a comfortably placed subject, increased arm tension with onset of verbal material might reflect application to a dull and difficult task. Such a conclusion is further supported by the single arm change, from pre-rest to listening, found in our study: a significant increase of

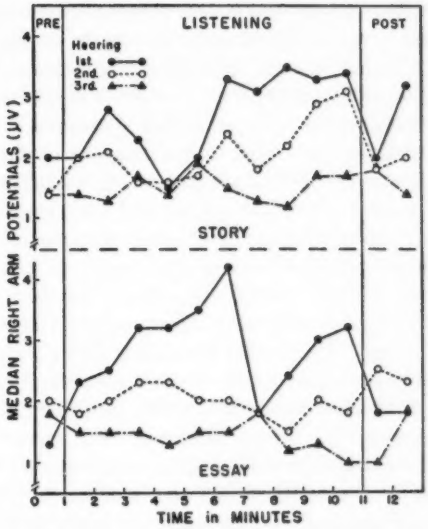

FIGURE 4. Effects of listening to a detective story and philosophical essay on right extensor muscle tension. Approximately five minutes intervened between each presentation.

right extensor potentials with first presentation of the essay. No increase occurs for the second and third presentations, where the essay is presumably easier to grasp, and where most subjects report greater interest.

From chin and *frontalis*, Smith and his co-workers obtained a rising gradient to the fourth minute of listening, then a fall to the end of their six-minute article. Their interpretation was that the subjects attended for a few minutes, this attention being reflected in continuously rising muscle potentials. After the fourth minute, the individuals became bored and tension fell. This view was supported by some retrospective reports of boredom and sleepiness setting in before the article ended. *Frontalis* and chin curves in the present study showed a rise throughout listening, and our subjects failed to report a loss of interest during the record. Again one might say that continuous attention is reflected in rising gradients in particular muscles. But why should this be the case?

It may be that sustained thought *per se*, i.e., attention alone, would lead to increasing muscular activity. Such an occurrence might conceivably take place if a person were deliberately persisting along certain lines of thought, despite increasing difficulty, distraction, or boredom. The gradients would thus represent compensatory effort for decreasing efficiency in carrying through a task. Though such a possibility cannot be entirely

ruled out, its likelihood is questionable. Distraction in the present study was minimal, and bored subjects were not forced to listen; witness the two individuals who fell asleep. As for difficulty, one might expect listening to the story to yield gradients of smaller magnitude; in fact, these were larger. Further, the size of the *frontalis* gradients showed an orderly (albeit small) increase from first to last hearing of the essay. Finally, only the last presentation yielded a significant gradient on the chin when the essay was listened to. It would appear that ease, rather than difficulty, is a positive factor here. Greater familiarity with and comprehension of the material seems to make for larger increases of tension during the course of listening (all this, admittedly, within the narrow range of our experiment; three successive hearings may not have allowed for extreme familiarity to develop). Now, terms like comprehension bring us to grips with the organizing functions of the thought process. To face this aspect more directly, a distinction between hearing and listening is in order.

Increase of organization during listening. The term *hearing* implies passive reception of the incoming auditory stimuli; the term *listening*, active integration of these stimuli. In our experiment, these stimuli, already organized into a familiar language structure, constitute items of information. The present thesis holds that these items did not merely impinge on the subject's auditory mechanisms, but were actively selected and organized by him. The individual's attention involved a set to understand, that is, to integrate the information. As the record played on and the number of items increased, the extent of the subject's organization also increased. Rising gradients of tension from *frontalis* and chin muscles may thus reflect growth of psychological organization.

To account for the correspondence between psychological organization and muscular tension, we shall turn briefly to the neuropsychological theory recently propounded by Hebb (5). Through learning (especially learning during early life) numbers of central neurons interconnect to form distinct groupings (assemblies) more or less permanent. A single assembly may denote a simple item in physical space—a triangle, for example. These simple items become organized into larger units, through sequential action of a number of assemblies firing in proper phase. A phase sequence might underlie a patterned mosaic, composed of simpler assembly units like triangles, circles, and squares. Now for our present thesis, the discrete stimuli are not geometrical forms, but word symbols. Word items referring to simple objects or events correspond to cell-assemblies. Patterns of such items, i.e., higher-order structures like sentences and paragraphs, involve higher-order neuronal action, namely, phase sequences. Through reverberation (self-stimulation) these units may maintain a course independent of sensory stimulation and motor

response. This process is, of course, not completely independent. Central and sensory processes may reinforce each other or come into conflict. Similarly, central and motor components interact, leading to central facilitation or inhibition of muscular and overt action. A directed system, involving a degree of central independence in congruence with a degree of central-peripheral interaction, may constitute the thought process. Increasing organization of such a system may constitute growth of the thought process.

Returning to our experiment, it seems that *frontalis* tension constitutes a motor aspect of the phase sequence. It reflects reinforcement of the sequence with onset of listening, further recruitment of subsumed assemblies during listening, and decline of organization with end of listening. Chin muscle activity supported this picture, whereas muscles of the forearms proved negative. It may well be that during thinking muscles of facial expression and speech are particularly prone to direct central facilitation.

One finding of interest here is the failure of tension to fall significantly after the essay is heard. The poorer memory scores and smaller gradients suggest that the essay was not as well understood as the story. When an interested subject does not fully comprehend the material listened to, he may continue thinking about it after it has ended; whereas more fully understood material may fail to occupy his attention to the same degree. Neuropsychologically, the more fully organized phase sequence "short-circuits" more rapidly (**5**, pp. 227 ff.).

Wakefulness

One more pattern of findings, suggesting some independence between degree of wakefulness and other aspects of thought, merits consideration. The results have shown an orderly decrease in pre-rest level of *frontalis* tension from first to third hearings. *Frontalis* tension gradients during listening failed, however, to show a similar decrease. Also, retrospective reports indicated an increase of sleepiness from one hearing to the next. These same reports, however, did not show a similar decrease of interest, attention, and anticipation.

It may therefore be that changes in the pre-rest level of *frontalis* activity reflect changes in wakefulness; that the differences in magnitude of the rising gradients reflect changes of attention and anticipation during listening; and that within the major limits of our experiment these two states are independent. Not within the entire limits, however; as indicated by the two subjects who failed to keep awake, and their decline in *frontalis* tension prior to actual onset of sleep. Falls of *frontalis* potentials preceding sleep have previously been reported by Travis and Kennedy

(9), whose subjects also showed poorer reaction time performance with decreasing *frontalis* activity. It may be that attention and anticipation are more intimately bound to alertness when a subject is nearing sleep, and less so when he is wide awake.

At present, however, this distinction between waking level and the more directive aspects of thought is only tentative, and awaits the test of further research.

Summary

In an experiment designed to investigate muscular activity during sustained attention, two groups of subjects were requested to listen to three successive presentations of a recorded detective story and philosophical essay.

Results showed rising gradients of tension from forehead and chin throughout the course of listening. Listening to the story tended to produce increases of greater magnitude than did listening to the essay. Forearm muscles failed to show any clear variations during listening.

The rising gradients of muscle tension may be associated with increasing comprehension or organization of incoming verbal material—organization which may take place during attentive listening.

REFERENCES

1. Bartoshuk, A. K. An electromyographic study of goal-directed activity. Unpublished master's dissertation, McGill Univer., 1951.
2. Bartoshuk, A. K. An electromyographic study of goal-directed activity. Paper read at Canadian Psychological Association, Kingston, May, 1953.
3. Courts, F. A. Muscular tension and performance. *Psychol. Bull.*, 1942, **39**, 347–369.
4. Davis, J. F. *Manual of surface electromyography.* Montreal: Laboratory for Psychological Studies, Allan Memorial Institute, 1952 (mimeo.).
5. Hebb, D. O. *Organization of behavior.* New York: Wiley, 1949.
6. Inman, V. T., Ralston, H. J., Saunders, J. B., Feinstein, B., & Wright, E. W. Relation of human electromyogram to muscular tension. *J. Electroenceph. clin. Neurophysio.*, 1952, **4**, 187–194.
7. Smith, A. A. An electromyographic study of tension in interrupted and completed tasks. *J. exp. Psychol.*, 1953, **46**, 32–36.
8. Smith, A. A., Malmo, R. B., & Shagass, C. An electromyographic study of listening and talking. *Canad. J. Psychol.*, 1954, **8**, 219–227. (Abstracted in *Amer. Psychol.*, 1953, **8**, 437–438.)
9. Travis, R. C., & Kennedy, J. L. Prediction and automatic control of alertness. *J. comp. physiol. Psychol.*, 1947, **40**, 457–461.
10. Wilcoxon, F. *Some rapid approximate statistical procedures.* Stamford, Connecticut: American Cyanamid Company, 1949.

BOOK REVIEWS

Tâche, réussite et échec. Théorie de la conduite humaine (Task, success and failure. A theory of human conduct). By J. NUTTIN. Louvain: Publications Universitaires (Paris: Editions "Erasme" S.A.), 1953. Pp. X, 530. $6.00.

IN RECENT YEARS, experimental psychology has been somewhat neglected by European psychologists. In Louvain, however, Professor Michotte and his collaborators have worked patiently from the beginning toward a synthesis of our theoretical and experimental knowledge of the psychic organism. To a long list of excellent publications from these laboratories Professor Nuttin has added a new contribution which, in the opinion of the reviewer, will attract the interest of most psychologists in America as well as in Europe.

This work speaks for the wide experience of its author in two fields too often divided: experimental and clinical psychology. The author's hypotheses undoubtedly spring from his clinical background, but they have been tested for several years in a series of sound experimental studies. His personal contribution toward a theory of human behaviour is based also on an excellent critical review of the literature, which is not limited, as is too often the case, to one period, school, or language.

The first part of the volume is the logical sequel to the last of Professor Nuttin's books, *Psychoanalysis and Personality*; it could have been entitled "An Experimental Study of Personality." It deals with a subject's perception of the result of his activity as an experience of success or failure. The personality factors affecting these perceptions and the memory of them are the object of a detailed analysis. The perception of action and of its results is, in the author's theory, a regulatory mechanism reflecting a need for internal consistency which characterizes the psychic as well as the biological organism. This part of the book is a concrete example of the fruitfulness of an intelligent integration of experimental and clinical data.

The second part deals with the influence of the results of action on the subsequent behaviour of the subject. This is the problem of learning. Some of the experiments presented here are admittedly similar to experiments published elsewhere. Each of them, however, is meant to test a specific hypothesis of Professor Nuttin, and they all lead to the elaboration of an original and personal theory. Taking full account of the classical work on the learning of animals, the author proceeds to a re-evaluation

of the laws of effect and reinforcement on the basis of experiments dealing exclusively with human subjects. Human and animal motivation are compared, and the differences which are important for the interpretation of behaviour are pointed out. This develops into a new theory of learning, which might be placed somewhere between Tolman's cognition theory and the reinforcement theory of Hull.

The last chapter is an original synthesis of the whole process of human activity. The author stresses the specific character of the various functions contributing to behaviour, and shows the fundamental importance of their mutual integration for the adequate understanding of each of them.

Many will be surprised to find in a work on behaviour a lack of any reference to our knowledge of neurophysiology. The theory presented here is purely psychological and deals with *human* motivation; it does not exclude the strictly biological factors but postulates that any additional explanations in terms of body chemistry and nervous mechanisms will be readily and naturally integrated with an adequate theory of human behaviour.

This is a new and stimulating point of view which opens the way towards a re-evaluation of behaviour theory, especially in the fields of learning and personality. An extensive bibliography (700 titles, including very recent articles and books) increases the value of this excellent work.

DAVID BÉLANGER

Université de Montréal

The Grassi Block Substitution Test for Measuring Organic Brain Pathology. By JOSEPH R. GRASSI. Toronto: Ryerson Press, 1953. Pp. 75. $3.25.

THE GRASSI TEST consists of a set of coloured blocks of the type originated by Kohs, and is designed to demonstrate impairment in both concrete and abstract thinking. The manual describes the materials, administration, and scoring procedures, and provides data for quantitative and qualitative interpretation of both organic and functional pathology. The standardization, based on 276 cases, includes normals, schizophrenics, organics, and post-lobotomy adult subjects. In the words of the author, the test shows promise of being "particularly sensitive to early and minimal organic changes, which, perhaps, enhances its value over and above that of the commonly used organic tests which in many cases reveal organic signs only if pronounced changes are present." This diagnostic device may prove to be a valuable addition to the growing field of neuropsychology.

J. G. MCMURRAY

University of Toronto

8, No. 4

ts deal-
tion are
retation
earning,
theory

human
unctions
ance of
f them.
of any
esented
loes not
ditional
will be
nan be-

way to-
ields of
cluding
t work.
LANGER

n Path-
5. $3.25.

ginated
oncrete
inistra-
ve and
gy. The
hrenics,
author,
d mini-
l above
reveal
gnostic
neuro-

MURRAY

New Books in Psychology

A DYNAMIC PSYCHOPATHOLOGY OF CHILDHOOD

By Lauretta Bender, New York University College of Medicine. The third book of the Bellevue Studies of Child Psychiatry. It deals with the various areas of psychopathological responses in the child frustrated by problems, their expression during childhood and their influence on the subsequent development of the personality in adolescence and early adulthood. $8.25

THE MANAGEMENT OF MENTAL DEFICIENCY IN CHILDREN

By I. Newton Kugelmass, New York City. The mechanism and management of mental deficiency in infants and children. The author analyzes the newer knowledge and assembles these perplexing disorders into an integrated system of syndromes. Such an approach enables a complete classification of mental defects based on overt clinical features. $7.50

GROUP THERAPY FOR MOTHERS OF DISTURBED CHILDREN

By Helen E. Durkin, New York City. "Dr. Durkin's contribution here, stressing as she does, clinical judgment and relating the practice to diagnostic entities, supplements and elaborates earlier writings of other practitioners. As such this is a book of major importance."—S. R. Slavson, in the Foreword. $3.75

THE RYERSON PRESS
TORONTO